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THE UNIVERSITY OF ALBERTA

A STUDY OF THE INCIDENCE, NATURE AND CAUSES OF SPORTS INJURY TO SELECTED SCHOOL-AGE POPULATIONS

by

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A THESIS
SUBMITTED TO THE FACULTY OF
GRADUATE STUDIES AND RESEARCH
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EDMONTON, ALBERTA

SPRING, 1978

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "A Study of the Incidence, Nature and Causes of Sports Injury to Selected School-Age Populations" submitted by Heather Dianne Hartsell in partial fulfilment of the requirements for the degree of Master of Science.

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Date Dec. 6, 1977

"May there never develop in
me the notion that my
education is complete, but
give me the strength and
leisure and zeal to
enlarge my knowledge."

-Moses Ben Maimon

ABSTRACT

The purpose of the study was to determine the incidence, nature and causes of sports injuries occurring in organized and unorganized activity to the school-age participant, so that meaningful recommendations for the reduction or prevention of injuries could be made.

The accident report form was designed and placed in the schools prior to the study. The form was designed to allow for computer analysis of all sections and factors, using the S.P.S.S. method of programming.

During the two-year period studied 3,653 injuries to males and females in the Edmonton Public School System were recorded.

Within the limitations of the study, the following conclusions were drawn. Males showed a greater tendency toward injury, although the injury rate for females increased concomitantly with age.

Fourteen to fifteen years of age were the injury-prone years. Females were noted to reach a higher incidence of injury earlier than males as a consequence of earlier maturation.

Times of day frequent for injury coincided with the type of injury and the program phase frequently offered.

Recess was hazardous for the elementary grades, and physical education was hazardous for the secondary

grades. As the program phase became more structured and intense, the severity of injury increased. The injury rate declined when physical education was non-compulsory.

Contact sports were more hazardous to grades 10 to 12 (15 to 17 years), whereas non-contact sports were more hazardous to grades 7 to 9 (12 to 14 years). Intramurals were more injurious to grades 7 to 9 and interscholastics were more injurious to grades 10 to 12.

Generally, free play was the activity most hazardous at the elementary level. Basketball and gymnastics were most hazardous to the secondary level. In intramurals, basketball and touch football were high for injury. In interscholastics, tackle football and basketball were most injurious.

Probable causes of injury changed to complement the structure of the activity, rules and regulations, and changes in levels of competition.

Causes of injury reflected the nature of the activity, the level of organization, and the intensity of competition.

Generally, for ages 5 to 11 (grades K to 6) causes of injury did not involve an external object or person, whereas for ages 12 to 17 (grades 7 to 12) an external object or person was frequently involved.

Overall, as age, experience and exposure rates increased, the incidence and severity of injury increased concommitantly and complemented changes in the types of

activities, levels of competition and organization.

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CHAPTER I

STATEMENT OF THE PROBLEM

Introduction

Sport and physical activity have become an integral aspect of the Canadian lifestyle, and are becoming instruments of policy not only for the health and well-being of the athlete or avid participant, but also for the general population. Sport is no longer solely available for the individual demonstrating a particular athletic ability, but is now available to all Canadians who wish to participate. The opportunity for youth, in particular, to actively engage in sports has developed to the point where no-one need be excluded. Young men and women, of their own volition, are able to pursue intensive programs of physical activity day after day, week after week, month after month.

As leisure time increases, and the opportunity for participation is increased, the scope of medical problems to be prevented in sports activities naturally continues to broaden. Just as sport itself is requiring a continuously more dedicated approach, so too are the clinical problems, of a medical nature, associated with it.

Traditionally, injuries have been unquestioningly accepted as an inevitable by-product of participation in sports. With increasing knowledge in the various

sub-diciplines of physical education, a newer and more sophisticated outlook on sports no longer accepts this concept. The fact is recognized that involvement does entail a risk, and certain sports do harbor unquestioned inborn hazards. The inborn hazards are related to the increased exposure to activity, and the nature of the sport. The number of injuries may increase proportionately with increased numbers of participants, but the number of severe injuries which may possibly be reduced, and the number of minor injuries which may be prevented should not increase proportionately. Can sports be made safer?

When a review of the literature has been completed, the fact becomes evident that the incidence of injury appears to be higher than would naturally be presumed with the increased numbers of participants. Jokl (52) stated that in recent years the growing emphasis on recreational sports has caused a rapid increase in the number of injuries related to athletics beyond the rise in numbers of participants. The reasons for the increase in injuries have not been forthcoming.

A rather ironic situation exists. Man has the technology and ability to travel to the moon, and has a scientific understanding of the human tolerances that are required. He also has control, through the use of advanced safety programs, over the possibility of human failure. However, on earth, where physical activity, either organized or unorganized, is a normal intrinsic

phenomenon for humans, there is less control over its hazards. Injuries may be significantly reduced through correction and control of the hazards which predispose individuals, and through control of the individuals who may also cause injury. The need for a better understanding of the causes of injury is further enforced so that the elimination of unnecessary injuries and the reduction in severity of other injuries may become possible. The reduction of the numbers of injuries and control of the hazards are termed measures of prevention. An understanding of the causes of injury leads to suggested measures of prevention, which, in turn, reduces the incidence of injury, thus eliminating causes of injury. A cyclical relationship exists.

The factors of incidence, nature, and etiology, and subsequent interpretation of the data concerning injuries, are of the domain of sports medicine. One aspect of the field of sports medicine deals with the injury problems, and with the prevention of possible problems in the school-age participant. Sports medicine requires research in epidemiology, nature of injuries and underlying causes. Since young participants are able to be involved in a variety of activities ranging from sandlot play to structural leagues, a type of integrated research and research methodology utilizing a liaison between the physical educator, coach, practitioner, athletic therapist and physician is required

for effective results to be collected.

The idealistic goal is complete prevention of injury. Realistically, absolute prevention is impossible since injuries will remain one of the unfortunate aspects of sport as long as sport remains, but the incidence of unwarranted mishaps may be greatly reduced. Investigating the nature, incidence and etiology of injuries in the school-age participant will not only aid in injury control at young age levels, but may also aid in reducing the incidence of injury to the adult as well. Adults carry through their life many of the concepts acquired in childhood. The childhood years have been referred to as the formative years.

The best mode of prevention is to influence the causes of injury, and to do so the research performed must be meaningful and the information received must be directly applicable to the practitioner. Garrick (29) has stated that the evolution of a meaningful safety program in any given sport requires that potentially preventable problems be defined and assigned priorities, and that sufficient data be accumulated to uncover causal variables on which to base preventive programs. Such programs should fit realistically into the organized structure of the individual sport.

In epidemiology, the ideal for maximum benefit and injury prevention would be an indepth examination of up-to-date recordings of all injuries in all levels of

sport. Hopefully this ideal will occur in the near future. Sports medicine concerns itself with the care of all classes of athletes, and therefore any study concerning the causes and incidence of injury must be comprehensive.

The literature contains few studies pertaining to the incidence, nature and cause of injury in the young athlete engaging in specific sports, as well as the young participant in general activities. Individuals participating in unorganized activity constitute the majority of athletic injuries to the young participant, and yet there is a lack of a concerted and organized effort to reduce the occurrence of the injuries.

The literature indicates a high incidence of reinjury (32,34,70,73,91). The fact becomes even more important to prevent and control injuries occurring in the school-age participant so that recurrence in later years will not take place. The idea of studying causes and suggesting techniques of prevention will allow for a more complete and wholesome participation throughout the life span of the individual.

The public education system is an ideal setting for the investigation of injuries. The opportunity for participation, and the acquisition of skills and sports knowledge is made readily available, and thus channels for the employment of preventive measures are readily available and at the level where the greatest benefit

will occur. Activities are of a general nature, a variety of levels of participation exists, the circumstances are not artificial, and a cross-section of individuals is maintained.

The Problem

The purpose of this study was to determine, through the utilization of the survey technique, the incidence, nature and cause of sports injuries occurring in organized and unorganized activity to the school-age participant, so that effective and meaningful recommendations for the reduction in numbers of some injuries and prevention of those of an unnecessary nature could be made. These recommendations were to be of a realistic and practical nature for immediate and direct application by the coach, physical educator, athletic therapist, physician and school administrator.

The Need for the Study

Within the last decade, the question of injuries associated with sports participation has become a major focal point for physical educators, coaches and parents. Initially, the question of why these injuries occur had been directed toward physical educators, coaches, school administrators, recreation co-ordinators and athletic therapists. Due to the lack of answers the question has been redirected toward those in the field of sports medicine. Whatever the direction of questioning, the

answers have not been forthcoming. Asking whether all the injuries due to sports are necessary or whether one must assume injury to be inevitable if children actively participate in sports, are valid and legitimate questions.

The realization that children are not miniature adults must be recognized and kept in mind. Children represent the various stages of maturation into adulthood. Thus, the problems that they encounter must be dealt with on that basis. The child must be 'fit' to the sport, as well as the sport being 'fit' to the child. One means of ascertaining this 'fit-ness' is to investigate the nature, incidence and cause of sports injuries in organized and unorganized activity.

Many studies (2,9,11,12,14,23,28,32,39,42,47,48, 61,66,70,72,73,97,99,114,118) investigate the incidence of injury, and offer abundant data concerning the frequency of types of injuries occurring in various sports, but due to the investigative procedure, methods of analysis and data collection, the causes of sports injuries have been inadequately recorded. Even so, the authors of these studies have gone so far as to suggest preventive measures. The suggestions given by these authors are, in essence, of little or no true value without the interpretation and application of etiological factors.

A large gap also exists on the incidence, nature and cause of injury to school-age participants. This age group, spanning five years of age to seventeen years

of age, is a period of rapid growth and maturation. During this period, the musculoskeletal system is subject to varying degrees of development. These imbalances contribute to injury vulnerability of children in this age range. With this valuable knowledge concerning child development, the need is manifested to understand the reasons for injuries and how to prevent them. Only after the hazards of an activity and causes of injury are known can safe techniques, rules and other preventive measures be instituted in the schools. The need for changes in injury prevention in adulthood could be reduced, too.

The Edmonton Public School System desired feedback as to the incidence, nature and causes of injuries in their schools to enable the school system to improve the existing programs through changes in structure, organization and teaching methodology. This would possibly reduce the frequency of unnecessary injuries, as well as enhance participation safety.

The primary responsibility that physical educators, coaches and practitioners face in conducting programs in physical education, sports and athletics is one of providing optimal protection for the participant. The causes become important. If the causes of injury are unknown, the efforts of those concerned with sports medicine who effectively attempt to employ measures of prevention, are also impeded. The fact is not enough that the physical educators, teachers and practitioners simply

be made aware of the concepts; these people must also be able to structure learning experiences around them.

Only from the application of epidemiologic methods of research in a continuing study may enough be learned to enable changes to occur in athletic programs toward the reduction of injury.

Delimitations

In carrying out the study it became necessary to place a number of restrictions on the study and the sample. The delimitations were as follows:

1. The study incorporated data from the academic school years of 1974-1975 and 1975-1976.

2. Schools of the Edmonton Public School System in Edmonton, Alberta were used.

3. The reports were completed on a standard injury report form distributed to the schools.

4. Sample size was limited to those students registered with the Edmonton Public Schools for the previously mentioned academic terms.

Limitations

In addition to the aforementioned delimitations, there were further limitations which prevailed throughout the study. The limitations are serious in nature and will influence the final interpretations of the data for people taking the data and using it in a practical sense. The limitations were as follows:

1. Only those students who reported an injury and had an injury report form completed concerning the injury were considered. A reportable injury was an injury receiving first aid or medical attention, resulting in absenteeism from a class or a practice session; dental injury requiring professional attention; and an injury which led to cessation of the athlete's customary participation in sports, in practice/game up to twenty-four hours later.

2. Not all injuries may be assumed to have been reported. Some athletes may have either not reported the injury, or stated the severity of the injury as being of a lesser degree in order that permission would still be granted for continuation of practices and team play, and also to avoid peer commentary.

3. Injury assessment and completion of the injury report forms were by the coach, teacher or physical educator. The information on the forms was assumed to be accurate even though the competency and qualifications of the individuals assessing the injuries varied greatly.

4. Although the report form was intended to have been presented clearly, misinterpretation may have prevailed in some areas, and thus improper information may have inadvertently been given.

5. Error must be assumed, but hopefully minimized, in the process of collecting, interpreting, analysing and summarizing the accumulated data.

6. The information was limited by the nature and scope of the form.

Definition of Terms

Incidence of Injury. The rate of injury, often expressed as so many injuries per 1000 participant exposures. In the present study incidence of injury shall be taken as the number of new injuries occurring over a period of time and expressed as a percentage of the total number of injuries having occurred.

Child. Any male or female between the ages of 5 to 17 inclusive.

Nature of Injury. A description of the type of injury sustained in the accident. For example, a knee sprain or ankle fracture reflects the nature of injury.

Cause of Injury. An etiological analysis of an injury. In most cases, the cause or causes reflect the opinion of the teacher, coach, nurse, physician or student.

Body Region Injured. The area or locale of the body sustaining the injury.

Injury. A damage or hurt, done or suffered through a specific impairment of body structure or function caused by an outside agent or force.

Abrasion. A rubbing caused by friction, or a scraping off of skin to cause local pain, stiffness, tenderness and inflammation.

Burn. Injury to tissues caused by exposure to high temperatures or to factors causing the stimulation.

Bone Bruise. A large, blotchy, superficial discoloration of a bony area with swelling due to hemorrhage into the tissues from ruptured blood vessels.

Concussion. A violent shock or jarring of the brain caused by a direct blow to the head causing various degrees of nausea, dizziness, ringing in the ears, unsteadiness, mental confusion, loss of memory, loss of consciousness, impairment of neural function, retrograde amnesia.

Contusion or Muscle Bruise. Injury to soft tissues caused by a direct blunt force which does not cause a disruption or laceration of the surface, but does create local pain, stiffness, tenderness, bleeding and swelling into the surrounding tissues with subsequent discoloration and hematoma formation.

Dislocation. Total displacement of a joint with loss of articulation of normally opposing joint surfaces caused by a direct or indirect blow or fall, and characterized by pain, tenderness, deformity, swelling, and loss of function. A subluxation is an incomplete dislocation.

Fracture. A loss or break in the continuity and integrity of the structure of bone caused by a direct blow, indirect trauma or a fall, and characterized by possible deformity, pain, tenderness, swelling, bleeding,

loss of function.

Laceration. Trauma causing a break in the continuity of the skin having irregular edges and characterized by bleeding, pain and tenderness.

Nosebleed. Bleeding from the nose, usually the result of direct trauma causing a rupture of small blood vessels.

Puncture. A wound in the skin caused by penetration of a sharp object, usually continuing deep in the tissues, and characterized by local pain, bleeding, tenderness, and loss of skin continuity.

Sprain. Occurring to the ligaments of a joint caused by direct or indirect trauma producing a twisting or moving of a joint beyond its normal range with subsequent stretching or tearing of the fibres of a ligament. It is characterized by varying degrees of disability, loss of function, abnormal range of movement, swelling, pain, tenderness, hemorrhage.

Strain. Occurring to a muscle caused by trauma to a portion of the musculotendinous unit due to violent contraction, excessive forcible stretch or over-exertion which causes a stretching or tearing of muscle fibres. It is characterized by various degrees of local pain aggravated by muscle movement, swelling, hemorrhaging, tenderness, loss of function, abnormal movement patterns, spasming, strength loss.

Tooth Fracture. Obvious deformity or loss of

normal structure of a tooth caused by direct trauma or violent occlusion.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The literature review dealing with the investigation of the nature of injury and the causes of injury is very scant indeed. More studies have been completed concerning the incidence of injury, but few of the studies referring to incidence of injury involve general sports injury coverage. Specific studies concerning individual sports are of some value, but the methods of selection and circumstances for participation are more discrete.

Direct comparisons between individual studies are often not meaningful since the emphasis on a particular sport, approach to the sport and interpretation of the results varies with the country, district or region studied. The studies need not be ignored, since the cited information is significant to the point that injury trends are suggested, and a foundation is provided for the consideration of a more detailed investigation.

The majority of injury studies has been focused at the university, adult amateur and professional levels, with a strong tendency to overlook and ignore the school-age athlete. Emphasis needs to be redirected.

Methods of reporting and recording of injuries and the frequency of injured were so varied and diverse, and involved qualified and unqualified personnel, that

comparisons of the results of the studies are difficult. Until such time as a universal and accurate injury report system evolves, reliance on the credibility of the literature is necessary.

Incidence of Injury

General Studies on Physical Activity

In 1968, Mendryk and Dickau (77) reviewed athletic injuries in the Edmonton Public School System. The authors compared the results of 1965-66 and 1966-67 and found no significant change in the incidence of injury for the elementary grades. The approximate incidence of injury was reported as 22 percent. At the junior high school level the injury rate increased from 65.7 percent in 1965-66 to 70.9 percent in 1966-67. High school sports injuries increased from 67.2 percent to 71.8 percent over the two-year academic term. For grades kindergarten to 6, injury frequency increased coincidentally with increasing grade level, but no apparent pattern surfaced concerning significant differences of injury to males or females. Gymnastics, track and field, volleyball and basketball accounted for three-fifths of the injuries in junior high school. For senior high school, gymnastics, football, basketball, and track and field accounted for 62 percent of the injuries. Grade ten was observed as being a peak grade for injuries, more than any other grade.

Similar results were recorded by Mendryk and King (78) from an analysis of play, physical education and athletic injuries in the Edmonton Public and Separate Schools in 1968. The incidence of injury increased as age increased. The result was demonstrated to remain true until grades eleven and twelve when physical education became optional. Results for kindergarten to grade 6 demonstrated gymnastics and free play to record the highest incidence of injury. The majority of injuries to the elementary grades occurred during 10:00 a.m. to 11:00 a.m. The time period second for incidence of injury was 2:00 p.m. to 3:00 p.m. The hour of 12:00 p.m. to 1:00 p.m. ranked third for incidence of injury. As the grade level increased, so did the frequency of injury during physical education classes, particularly at the grade 7 to 12 levels. Sports causing the greatest number of injuries for grades 7 to 12 were basketball, track and field, volleyball and soccer, in descending order. Males demonstrated a tendency to be injured more frequently in basketball, gymnastics, soccer and track and field. Females were injured more frequently in basketball, volleyball and gymnastics. For grades 7 to 12 no specific times of the day were peak times for injury since the majority of injuries occurred during physical education classes which were evenly distributed throughout the day. Interscholastic activities ranked second for incidence of injury. The peak age for injury for

males was fourteen. For females the peak age for injury was thirteen. Collins (12) studying contact sports in junior high school, found the incidence of injury highest at fourteen years of age for males. Mendryk and King (78) explained the difference of peak years of age for injury for the sexes as being the result of early maturation and the earlier onset of puberty for females.

The most recently completed study was carried out by Mendryk et al. (76). The study was comprised of a random selection of schools in Alberta. Divisions of grades kindergarten to 6, 7 to 9, and 10 to 12 demonstrated incidence of injury increases with increasing grade level. For grades kindergarten to 6, males sustained a 26 percent higher incidence of injury. A peak age for injury for males and females was eleven years. Elementary grades demonstrated peak times of day for injury to be noon hour, morning recess and afternoon recess, in descending order of frequency occurrence. Dale et al. (16) concluded the same times of day to be high for injuries to the elementary grades. The incidence of injury was reported by Mendryk et al. (76) to have increased from age 10 to 15 in grades 7 to 12, but dropped after age fifteen. The incidence of injury being greater for grades 7 to 12 was explained by the increased number of participation hours, the greater exposure, the difference in the nature of the sports, and the increased degree of contact in the sports. Interscholastic

competition yielded the highest incidence of injury per number of participants. Males demonstrated a higher incidence rate, but if the male-oriented sports were eliminated, the incidence of injury to females (47 percent) was close to the rate for males (53 percent). The incidence rate decreased in grades eleven and twelve at the high school level. Dangerous times of day were calculated to be 12:00 p.m. to 1:00 p.m. and after 4:00 p.m. which coincided with intramural and interscholastic participation respectively. During physical education classes, the gymnasium was reported to have the highest incidence of injury. The playing fields ranked second, and interscholastic competition ranked third for incidence of injury.

Mendryk et al. (76) proceeded to analyse individual sports for grades 7 to 12. Basketball accounted for 16 percent of all the injuries and approximately one-half occurred in physical education classes. No differentiation between incidence of injury and sex was demonstrated. Fourteen year olds sustained the greatest number of injuries. Touch and tackle football accounted for 16 percent of the injuries. Interscholastic competition accounted for 89 percent of the tackle football injuries, and physical education classes were responsible for 55 percent of touch football injuries. Grades 10 to 12 represented 93 percent of the tackle football injuries. Grades 7 to 9 represented 85 percent of the touch

football injuries. Peak ages for incidence of injury were fifteen years and thirteen years for tackle and touch football respectively. For gymnastics 84 percent occurred during physical education classes. Fifteen year olds received the most injuries. One-half of the injuries were the result of participation on the apparatus. Grades 7 to 10 were involved for 95 percent of the injuries. Track and field represented 8 percent of the injuries. Approximately three-fourths occurred during physical education instruction. Grades 7 to 9 accounted for 90 percent of the injuries in track and field. Fourteen year olds accounted for almost one-half of the injured in grades 7 to 9. Incidence of injury, in track and field, for males was 55 percent and for females the incidence of injury was 45 percent. Volleyball accounted for 8 percent of the injuries, and 64 percent were sustained during physical education classes. Grade nine was a peak grade for injury, representing 41 percent of all the volleyball injuries. Ages fourteen and fifteen received 57 percent of the injuries in volleyball. Physical education classes were reported to maintain the highest incidence of injury for wrestling (76 percent), floor hockey (73 percent), rugby (62 percent), soccer (60 percent), handball (92 percent), and baseball (43 percent). Grades nine and ten were highest for incidence of injury in wrestling and handball, while all the soccer injuries and 85 percent of the baseball

injuries occurred in grades 7 to 9. Floor hockey injuries were more frequent in grades 8 to 10, while all the rugby injuries occurred in grades 10 to 12. Generally, injuries from contact sports were most frequent in grades 10 to 12.

Parrish et al. (82) reported males were injured more frequently, at 72 percent, in public schools. The overall frequency of injury was higher in grades kindergarten to 3. The authors hypothesized the frequency of injury was the result of inadequate co-ordination and musculoskeletal skills, primarily. The injury rate decreased for grades 4 to 10, but increased for grades eleven and twelve. The difference in rate was attributed to the nature and competitiveness of the sports engaged in at the higher grade level.

Dale et al. (16) studied injuries occurring in public schools over a one-year period and found that grade two or seven year olds were injured the most often, at the elementary level. Eight year olds were injured the second most frequently and ten year olds were injured third in frequency. Playgrounds accounted for three-quarters of the injuries. The gymnasium was reported to account for one-tenth of the injuries.

In 1973, Medved and Pavisic-Medved (75) studied injuries occurring during physical education classes and sports in public schools. Physical education classes accounted for the highest incidence of injury for all

grades. Open-field situations represented 64 percent of the injuries in physical education classes.

Smith (101) reported that students in the seventh grade were the most frequently injured at the junior high school level. Grade eight results indicated fewer injuries than grade seven, and grade nine results demonstrated fewer injuries than grade eight. Thirty-five percent of the injuries, and the highest percent for any grade, were sustained in physical education classes. Males showed a tendency to be injured more frequently in track and field, secondly in tumbling, and thirdly on gymnastics apparatus. Females were injured most on gymnastics apparatus, secondly in tumbling, and thirdly in track and field.

Lingard, Sharrock and Salmond (66) completed a six-month study in New Zealand and reported that rugby accounted for 56.8 percent, soccer accounted for 11.2 percent, basketball and hockey accounted for 5.5 percent and 3.3 percent respectively, of the total number of injuries. Trends from the data indicated that injuries increased concomittantly with an increase in age. As students progressed from grades kindergarten to 12, the incidence of injury increased. Males in particular, of thirteen years or younger were rarely injured. The authors explained the lack of injury was the result of the level of competition and the velocity of impact which differed with age. Females were injured less frequently

and the injuries sustained were more minor in nature.

The concept of younger participants sustaining fewer injuries was reported by Collins (12) in his eight-year study on junior high schools. Football yielded the greatest percentage of injuries (82.1 percent) with a peak in injury rate occurring to grade nine, or fourteen year olds. Basketball ranked a distant second with 10.2 percent of the injuries. Grade seven, or twelve year olds, received the fewest injuries.

Bowers (6) reported similar results to Collins at the high school level. Football was the sport highest for incidence of injury. Of all high school athletes, 70 percent were injured in football. Eighty percent of all junior high school athletes were injured in football. Basketball accounted for 19 percent of high school injuries, and 10 percent of all junior high school injuries.

Individual Sports Studies

Much of the literature concerning injuries to the school-age athlete has stressed specific, individual sports. As a consequence, analysis of the injuries was able to be completed in a more indepth nature, of the types of injury and the causes.

Davis (17) conducted a study of football injuries to a high school league in Texas in 1962. One-tenth of all injuries occurring in high school were the result of football.

In 1969, Dufresne (19) studied football injuries to bantam, high school and junior levels of play in Edmonton, Alberta. The author reported that approximately 40 percent of the players received injuries. Eighty-six percent of the injured were twenty-one years or younger. A peak for injuries occurred at sixteen and seventeen years of age.

Contrary to the previous findings reported by Davis and Dufresne, Clawson and Roser (9) demonstrated young boys of 9 to 15 years of age were more injury prone. The authors attributed this finding to a lack of physical and emotional maturity.

Statistics from a junior league football study by Godshall (33) in 1975 demonstrated the injury rate of fifteen year olds or younger to be low (20 percent), because the athletes did not hit as hard. Godshall concluded the severity and incidence of injury varied directly with age but in close correlation.

Robey, Blyth and Mueller (92) observed similar results to Godshall. The data indicated 54 percent of the injured athletes were seventeen years of age or younger. The explanation given was that the older athlete was exposed to greater risks and to more competitive levels of activity. Possibly greater injury experience by age was a function of physical immaturity rather than age.

Reeves and Mendryk (87) studied hockey injuries to 9 to 18 year olds in Edmonton, Alberta. Over a one-year

period the authors noted the incidence of injury to be 5 percent. Seventeen and eighteen year olds received 25.2 percent of the total number of injuries. As demonstrated with football, the incidence and severity of hockey injuries decreased with age.

Hussey (23) reported an injury rate of twenty-nine per thousand for athletes of 7 to 25 years of age in amateur hockey, in 1976.

In 1977, Wilson et al. (113) concluded that as age and experience increased the injury rate increased, and contradicts the findings of Reeves and Mendryk. Wilson et al. noted the injury rate also increased as the number of participants increased, in a 2:1 ratio.

McLatchie (72) in 1976 studied the combative sport of karate and concluded injuries were more frequent to the lower grade participants of 10 to 17 years of age.

Kramer (6) demonstrated the number of soccer injuries varied indirectly and the severity of injury varied directly with the level of player ability. The study surveyed athletes of high school ages.

Curtin and Key (15) studied soccer injuries to athletes of school-ages and reported 53 percent of the school-age athletes were 10 to 20 years of age. The data indicated that organized soccer recorded the highest injury rate.

Ski injury studies have been conducted with greater regularity than most sports, but the results of

the studies were difficult to compare since the methods for the recording of the data, the interpretation of the results and the qualifications of the individuals recording the injuries varied greatly.

In 1962, Clayton (10) surveyed ski injuries to the general population in the United States. Results indicated that the 13 to 17 year age range sustained the highest injury rate. Fifty percent of the total injuries occurred to school-age athletes but the school-age athlete represented only one-fifth of the total skiing population. Females received the greatest number of injuries. After skiers had skied for two years, Clayton found the injury rate to decrease rapidly and concluded that experience and severity of injury were directly proportional, due to an increased difficulty of terrain and greater acquisition of speed. Clayton demonstrated 28.4 percent of the injuries were to 13 to 17 year olds. The 7 to 12 year age range accounted for 11 percent of the injuries, and the 18 to 21 year age range accounted for 21.8 percent of the injuries.

Richards (89) found comparable results to Clayton. The study was conducted in Jasper, Alberta during 1968. Results demonstrated that as the level of experience increased, the injury risk rate decreased. Twenty-eight percent of the injuries occurred to 13 to 17 year olds, while the 18 to 21 year old group received 21 percent of the injuries. Males represented 65 percent of the

injured.

Young et al. (117) conducted an eight-year study of the skier and the equipment. Results demonstrated that young skiers up to eighteen years of age are more prone to injury. The injury rate peaked at seventeen years. The authors explained the previous facts by stating that the lack of years experience and lack of ability increased the probability of injury.

Eriksson (24) studied ski injuries to Swedes and concluded 42 percent of the injuries occurred to fifteen year olds or younger. Downhill skiing accounted for three-fourths of the injuries, and of the fraction, 93 percent of the injuries were classified as recreational.

The incidence of injury varied from 3.4 per thousand as reported by Gutman, Weisbuck and Wolf (36) to 4.5 per thousand as reported by Ellison (23). Beginners demonstrated a tendency for injury of five times greater than expert skiers. Teenagers and females were injured most often (23,24).

Garrick (28) and Curtin (14) reported, in separate studies, that approximately 75 percent of the injured were beginners, and a little over one-half of the injured beginners had obtained no formal instruction. The injury rate was noted to have decreased markedly (by 72 percent) after five years of skiing experience and increased ability (28).

Intramural Sports Studies

Intramural injuries were studied by Kraus and Gullen (63) over a nine-year period. Touch football accounted for the highest incidence of injury at 8.7 per thousand participants. The authors concluded that the older the player the higher the risk rate. Parsley (83), seven years later found comparable results to Kraus and Gullen.

Incidence of Re-injury

The incidence of re-injury was reported in the literature to be high (63,73,92). Kramer (59) reported a 29 percent re-injury rate to soccer players. Graham and Bruce (34) demonstrated that 41.1 percent of the injuries during the study were re-injuries. Robey, Blyth and Mueller (92) demonstrated a re-injury rate of 27 percent.

Level of Activity

Regardless of the sport, the literature reviewed demonstrated that organized games and competition yielded a higher incidence of injury than practice sessions (9, 17,18,19,31,46,57,73,88,93,94).

Mendryk et al. (76) reported free play at noon hour and recess times to account for 60 percent of the injuries in unorganized activity. The playing field accounted for 53 percent of the injuries during unorganized activity, while 30 percent occurred in the gymnasium during

organized activity. For kindergarten to grade six, 31 percent of the injuries occurred during physical education classes, 34 percent during recess and 31 percent during free play. For grades 7 to 12 physical education classes accounted for the majority of the injuries. Three-fourths of the injuries in physical education classes were open wounds, bruises, sprains and dental injuries. A similar pattern was noted for organized activity, but fractures were included in the list of the types of injury. Open wounds, bruises, sprains, fractures and dental injuries accounted for 82 percent of injuries in organized activity. The same types of injuries of organized activity accounted for 78 percent of the injuries in unorganized activity.

Mendryk and Dickau (77) reported the majority (63 percent) of the injuries to grades kindergarten to 6 to occur during gymnastics, and 32 percent occurred on the playing field. Ninety percent of the injuries occurred during the regular physical education classes. For junior high school the authors demonstrated that 75 percent of the injuries occurred in physical education classes. Two-thirds of the junior high school injuries occurred in the gymnasium and the remainder were accounted for on the playing field. For high school, three-fourths of the injuries were accounted for in physical education classes. Fifty-nine percent of the injuries occurred in the gymnasium and 32 percent occurred on the playing

field.

Johnson et al. (50) found for grades kindergarten to 6 that playgrounds accounted for 33.1 percent of the injuries as a result of ball games. Falls on the playground accounted for 16.2 percent, horseplay accounted for 15.3 percent, and 28.9 percent occurred in physical education classes. One-half of the injuries occurring to grades 7 to 9 resulted from physical education classes, and three-fourths of the injuries to grades 10 to 12 occurred during physical education classes.

Nature of Injury

General Studies on Physical Activity

Mendryk and Dickau (77) reported data indicating the fingers, ankles, head and face to be the most frequently injured body parts. At the elementary level, face and head injuries were the most common. Injuries to the ankle and finger ranked second in frequency. Junior high school results demonstrated the exact reverse. Ankle and finger injuries predominated, while head and face injuries ranked second. For high school, injuries to the ankle and finger were the most frequent. Face and back injuries ranked second for frequency of injury.

Data from a study conducted by Mendryk and King (78) demonstrated the head, face, and teeth accounted for the majority of the injuries. Injuries to the hand, particularly to the fingers, ranked second. Injuries to the

foot, ankle and knee were also frequent. Data for grades 1 to 3 demonstrated head, face and dental injuries predominated. The knee was the region injured the next most frequently. The types of injuries sustained were primarily contusions and lacerations. Grades 4 to 6 demonstrated a similar pattern of types of injury as grades 1 to 3, with injuries to the head, face and teeth predominating. Injuries to the ankle and hand were second for frequency of injury. Sprains, lacerations, contusions and fractures collectively constituted the majority of the injuries. The highest incidence of dental injuries occurred to grades 4 to 6. For grades 7 to 9, fewer injuries occurred to the head. The hand was the single most affected area. The second regions for frequency of injury were the ankle and foot. Sprains were observed to be the single most common type of injury. Fractures ranked second, muscle strains ranked third, and lacerations ranked fourth, for frequency of injury. Collins (12) reported knee and ankle sprains to be the most common injuries for junior high school. Contusions ranked second and fractures of the hand and foot ranked third for frequency of injury. Grades 10 to 12 reported fewer accidents than grades 7 to 9, but the pattern of injury was similar. Males accounted for lacerations, fractures, sprains and contusions as the primary types of injury. Females demonstrated a tendency to sustain more sprains, contusions and fractures. The head received the

majority of lacerations. The arm, hand and in particular the fingers, were characterized by fractures and sprains. Relatively few injuries occurred to the trunk, and were primarily muscle strains. The authors attributed the injuries of the trunk due to a lack of emphasis on the development of the trunk and lower back strength. The foot, ankle and leg followed a pattern of injury similar to the hand.

The most recent study (76) concerning injuries to school-age athletes for the kindergarten to grade six category reports that 46 percent of the injuries occurred to the head, face and teeth. The injuries to the elbow, wrist, finger and thumb accounted for 20 percent of the injuries. Injuries to the lower limb represented 16 percent of the total number of injuries. For kindergarten to grade six open wounds to the head and face region, bone bruises, sprains particularly to the ankle and knee, and dental injuries accounted for four-fifths of the reported injuries. Sprains to the knee and ankle represented 70 percent of all sprains received by the elementary grades. Fractures predominantly occurred to the wrist, fingers and thumb. Grades 7 to 12 results demonstrated that 26 percent of the injuries occurred to the ankle and knee, 22 percent to the wrist, finger, thumb and hand, and 21 percent to the head, face, nose, teeth and eyes. Sprains accounted for over one-half of the types of injury. Fractures were next in occurrence.

Dislocations placed third for occurrence. Open wounds and contusions were common to all body areas. For grades 7 to 12, injuries to the foot and ankle were the most common injuries in tackle football, soccer, gymnastics and track and field. The foot, ankle, and head and face were the majority of the areas injured in basketball. Volleyball injuries occurred primarily to the hand. Injuries to the head and face predominated in baseball. Sprains were the most common types of injury received in tackle and touch football, basketball, soccer, gymnastics and volleyball. Fractures were the most frequent injuries in wrestling, rugby and baseball. Fifty-two percent of the sprains occurred to the ankle and knee. Fractures occurred most frequently to the hand (43 percent). Head and facial areas accounted for 60 percent of the open wounds. Half of the muscle strains occurred to the back. The thumb accounted for 28 percent of the dislocations. Overall, the joint regions were injured the most frequently. The ankle was injured the most frequently, followed secondly by the knee. Sprains, fractures and dislocations were the major types of injury.

Collins and Evarts (11) studied the adolescent athlete and concluded that for fourteen years or older, physical size belied the immaturity of the muscles and bones. Head and neck injuries were infrequent but serious when occurrence was noted. Shoulder dislocations were more frequent than fractures. Acromioclavicular sprains

were frequent to the athlete of fourteen years or older. Epiphyseal injuries were common. The authors explained that the epiphysis does not close entirely until the individual reaches the chronological age of eighteen years. The elbow was highly characterized by epiphyseal injury. The scaphoid bone was the most frequently injured bone of the hand and wrist in the adolescent athlete. Quadriceps contusions and strains were common. The knee appeared to be the most susceptible joint to injury, since in the adolescent the knee is weak. Meniscal tears increased in frequency after the age of puberty. In the lower leg, fractures of the tibia and fibula were common. Ankle injuries, particularly sprains, were second for frequency of occurrence after knee injuries.

In the study by Yost (116), cuts, lacerations and puncture wounds were found to be the most frequent playground injury. Contusions were the next most frequent injury. Broken limbs ranked third, and sprains ranked fourth for incidence of injury. The most frequent areas injured were the mouth, jaws and teeth. Head and eye injuries listed second and third respectively for incidence of injury.

Two studies investigated specifically fractures to children. Johnson et al. (50) reported grades kindergarten to 6 accounted for 43 percent of the fractures. The majority (approximately 50 percent) of the fractures occurred to the wrist, finger and hand. Grades 7 to 9

accounted for 30 percent of all the fractures. Fractured fingers accounted for almost one-quarter of all the fractures and was the highest body region fractured in grades 7 to 9. Grades 10 to 12 accounted for 27 percent of the fractures. Fractured fingers were the most frequent. Males received more fractures. The fracture rate increased after puberty. Generally for grades 7 to 12, the fractures were well-distributed over the body. Johnson et al. (50) noted that as the grade level increased, so did the fracture rate of the foot, ankle and face.

Siffert and Levy (99) found similar results to Johnson et al. With the adolescent, the dislocation occurred more frequently. Double fractures of the forearm were found to be more common before puberty, and the Colles fracture occurred more frequently after puberty. Tibial fractures of the lower leg were common to adolescents involved in sports characterized by violent pivotal forces.

Jokl (52) studied athletic injuries in very general terms and concluded the majority of injuries were soft tissue contusions. Second in frequency were abrasions and lacerations. Musculotendinous trauma ranked third and fractures ranked fourth for incidence of injury. The lower extremities accounted for 52 percent of all the injuries. Certain body regions were characterized by specific injuries. The ankle was characterized by sprains, the lower leg by muscle contusions and

strains, the knee by sprains, the thigh by musculotendinous trauma, the shoulder by sprains, and the wrist and hand by fractures.

Individual Sports Studies

Reeves and Mendryk (87) studied the nature of hockey injuries in Edmonton, Alberta for ages 9 to 20, over a one-year period. The majority of injuries (56.1 percent) occurred to the head, predominantly to the face. Hayes (40) in 1975 concluded similar results to Reeves and Mendryk. After injuries to the head, Reeves and Mendryk noted injuries to the mouth, teeth and eyes ranked second for frequency of injury. The mouth accounted for the highest rate of injury of any individual body area. Lacerations and contusions (35 percent of the types of injury) were frequent. The face accounted for 93 percent of the lacerations and contusions. Of the percentage, the eye accounted for 37 percent and the mouth accounted for 21 percent. Strains, sprains and fractures occurred after lacerations and contusions, in descending incidence of injury. Coventry (13), Toogood and Love (105), Kelly and Reeves (55), and Hornof and N'apravn'ik (46) found comparable results for types of injury. The results of Lingard, Sharrock and Salmond (66) demonstrated 33.2 percent of the injuries occurred to the head and neck, 33 percent occurred to the lower leg, ankle and foot, and 26 percent occurred to the hands,

fingers and forearm. The results of Hornof and N'apravn'ik (46) approximated Lingard, Sharrock and Salmond. The results of Reeves and Mendryk (87) indicated 16.4 percent of the injuries occurred to the mouth, 13.7 percent to the eyes, 8.1 percent to the nose, 7.4 percent to the neck, 7.4 percent to the leg, 4.9 percent to the wrist and 4.7 percent to the ankle. Ages 9 to 12 received mouth and dental injuries predominantly. Ages 13 to 14 received mouth and shoulder injuries. The age group 15 to 18 years accounted for hand fractures, nasal fractures and concussions primarily. Lacerations occurred most frequently (34.8 percent), fractures for 12.8 percent, and contusions of bone and muscle for 19.5 percent.

Wilson et al. (113) studied facial injuries that occurred to hockey players 7 to 19 years of age. Over a one-year season, three-fifths of the participants received a facial injury. The authors noted that as the age of the players increased, so did the rate of facial fractures and facial lacerations. The nose was the most frequently fractured facial bone. An increase in dental attrition was noted to occur as age and exposure rate increased.

Toogood and Love (106) studied hockey players 7 to 18 years of age and discovered mouth injuries accounted for 25 percent of all injuries, eye injuries for 15 percent, nasal injuries for 10 percent, and head injuries

for 18 percent.

Pashby et al. (84) investigated eye injuries in hockey and concluded from results over a two-year period that the highest incidence of eye injuries occurred to 11 to 15 year olds. The least number of eye injuries occurred to players younger than eleven years.

A study on rugby, in 1976, by Lingard, Sharrock and Salmond (66) reported head and neck injuries represented 34.5 percent of all injuries, the shoulder 14 percent and the ankle 10 percent. Fractures occurred frequently (21 percent), while lacerations were second for frequency at 11 percent of the injuries. The results of Roy (94) were comparable and demonstrated head and face injuries represented 20.5 percent of all areas injured. The knee and ankle represented 14.5 percent and 13.5 percent of the injuries, respectively.

In soccer, Kramer (60) reported the knee and ankle to be the most frequently injured body regions and that sprains were the most common injury to the regions. The lower extremities accounted for three-fourths of the total number of injuries. The ankle, foot and knee represented 70.8 percent of the injuries to the lower extremity. Contusion related injuries predominated. Contusions, lacerations, dental fractures and dislocations represented 65.9 percent of the injuries. Strains and abrasions totalled 16 percent.

In the C.I.A.U. soccer study by Kramer (59) an

injury frequency of 25 percent for sprains, 18 percent of strains, 23 percent for muscle and bone contusions, and 12 percent for fractures was noted. The results of Fardy and Anderson (25) in 1970 coincided with Kramer in 1976. Kramer (59) reported injuries to the ankle and knee represented almost one-half (42 percent) of all the injuries.

Yost (116) found the most common soccer injury was an abrasion to all body areas. Contusions were common to the quadriceps, sprains were common to the ankle and knee, strains were frequent to the gastrocnemius, and fractures were common to the toes, metatarsals, tibia and fibula.

For football, Wirtz (114) studied high school players and concluded the knee was the most frequently injured body region, and 87 percent of all knee injuries were sprains. Overall, sprains were the most common injury. Concussions, hand and finger fractures and shoulder dislocations accounted for 14.7 percent of all injuries.

Martin and Fuenning (73) studied football injuries over a two-year period and found the seriousness of injury had increased. Sprains represented 30.8 percent of the types of injury, contusions 25.4 percent, muscle strains 17.1 percent and concussions 6.5 percent. The knee was the most frequently injured body region at 18.1 percent. The ankle ranked second at 11.7 percent. The

head and face ranked third at 10.5 percent of the injuries.

Dufresne (19) studied athletes involved with high school, amateur and professional football teams. Bruises to the jaw, finger, thigh, knee, lower leg and ankle comprised 88.9 percent of the injuries to the 12 to 13 year olds. Sprains to the knee, ankle and neck represented 6.7 percent of the injuries to the 16 to 17 year old age group, with finger and shoulder dislocations totalling 7.2 percent. Overall, for 14 to 18 year olds in high school 34.2 percent of the injuries were to the knee and ankle. Sprains accounted for 20.7 percent of the knee and ankle injuries. Fractures to the nose, thumb, finger and ankle were more frequent than at the junior or amateur level. Concussions were more frequent at the high school level. In bantam play, or 12 to 15 year olds, concussions were reported to be non-existent, but contusions occurred as the most frequent injury (46.3 percent). Injuries to the ankle and knee totalled 19.5 percent of all the injuries. Fractures occurred three times more frequently at the high school level than at the bantam level. Muscle strains were common to high school and bantam levels of play. Sprains were six times more frequent to high school players.

Alley (1) studied head and neck injuries to high school football players and discovered head injuries represented 1 percent of all reported injuries and neck

injuries represented .6 percent of all the injuries. The majority of head injuries were minor concussions with symptoms of twenty-four hours or less. Moderate concussions accounted for 24.3 percent of all head injuries. Severe concussions and cerebral contusions accounted for 5.6 percent. The most common injury to the neck was a ligament sprain due to a hyperflexion mechanism. Necks were injured at a higher frequency during practices, but head injuries were more frequent during games.

Yost (116) reported grades 7 to 9 received 38 percent contusions, 33 percent sprains, 14 percent abrasions and lacerations, and 13 percent fractures, during football play. Sprains were the most common injury with 43.1 percent to the knee and 40.9 percent to the ankle. Strains represented 19.3 percent of the total number of injuries, and occurred to the neck, groin and shoulder girdle. Contusions to bony and soft tissue areas represented 24.2 percent of all injuries. The majority (35.7 percent) of the contusions occurred to the thigh. Fractures, totalling 10.3 percent of the injuries, occurred most often to the hand, ankle, finger and thumb. Dislocations and concussions occurred infrequently.

Young et al. (117) in 1976 observed data from injuries to skiers over an eight-year period. The authors concluded the majority of the injuries occurred to the lower limb. Eriksson (24) reported similar findings, and 72 percent of the ski injuries involved the lower limb.

Tibial fractures were most common to skiers of fifteen years or younger. Ellison (23) found sprains and fractures to predominate, with 80 percent of all injuries involving a leg, and 89 percent of all fractures involving a leg. Young et al. (117) observed ankle injuries to occur most frequently. Knee injuries ranked second, and lower leg injuries ranked third. Prior to 1968, ankle injuries represented 31 percent of all injuries and knee injuries represented 20 percent. Post-1972, ankle injuries dropped in frequency to 20 percent, but knee injuries remained at the same level. Over the years, modification of equipment has occurred and results have indicated that as the stiffness of boot increased, the incidence of tibia-fibula fractures followed an increase as well and in direct proportion. Ellison (23) found comparable results that the incidence of tibia-fibula fractures increased 40 percent over a two-year period, with the advent of a stiffer boot.

Richards (89) studied ski injuries at Jasper, Alberta. Results indicated injuries to the lower extremity accounted for 69 percent of the total number of injuries. Approximately two-thirds of the lower extremity injuries were received by 10 to 20 year olds. Fifteen to 20 year olds received slightly less than one-half of the ankle injuries. Beginners accounted for two-fifths of the knee injuries. For ages 10 to 12, two-thirds of the injuries were fractures. Sprains and fractures accounted

for 60 percent of the total types of ski injuries.

Studies by McLatchie (72) and Koiwai (57) were found to be the only investigations in the literature of hand to hand combat. McLatchie studied karate and discovered three main areas were injured most frequently. The face, head and neck accounted for the majority of injuries. Types of injury frequent to the areas were epistaxis (27.3 percent), mouth lacerations (27.3 percent), facial lacerations (9.1 percent) and concussions (21.2 percent). The trunk ranked second for incidence of injury. Types of injury frequent to the trunk were rib injuries (12 percent) and contusions (72 percent). Limb injuries were third for incidence of injury. Ankle sprains accounted for 18.2 percent of the limb injuries.

Koiwai (57) studied data from 1956-61 on judo competitors. Fractures (33 percent) occurred most frequently. Of the fractures, 58.8 percent occurred to the arms, and 29.4 percent to the legs. Dislocations accounted for 21.8 percent of the injuries, the majority occurring to the elbow. Sprains and concussions were minor occurrences.

Cause of Injury

The majority of articles in the literature were designed as descriptive studies to tabulate totals and types of injury. The studies were not designed to investigate precise causes of injury, even though causes of injury were hypothesized.

General Studies on Physical Activity

Worwick (115) attempted to define, in general terms, the causes of athletic injury. Causes were comprised of inadequate knowledge concerning injuries, insufficient skill or performance beyond the ability of the athlete, environmental hazards, improper attitudes, habits or play, and unsafe behavior.

Jokl (52) reported major causes of injury to include poor pre-season training, fatigue, and lack of rule enforcement.

Robey, Blyth and Mueller (91) reported that different types of protective equipment predisposed a player to injury and influenced the severity of the injury. Many injuries were reported to result from poor care of fields and facilities. Three-fourths of the injuries resulted from body contact with another player or contact with an object.

According to Glasgow (31) young athletes were found to be more prone to injury as a result of physical and emotional immaturity. The nature of play also increased the liklihood of injury. Glasgow stated that the young athlete became vulnerable to serious injury at fourteen years when physical size and courage belied the immaturity of bone and muscle development. Lack of warm-up was viewed by the author to be a more important causal factor than fatigue. Injuries occurred more frequently to minimally protected areas. Glasgow explained the high

rates occurring in random play, intramurals and unorganized sport were the result of inadequate protection. Lack of qualified supervision, inadequate instruction, failure to enforce rules, poor equipment and mismatching of participants were also suggested causes.

Mendryk et al. (76) demonstrated that causes of injury for grades kindergarten to 6, in descending order of occurrence, were falls or trips not due to an external cause, collisions between participants, blows delivered by an object, falls off gymnastics apparatus, and carelessness. During organized instruction, 66 percent of the injuries to the elementary grades were the result of accidental falls, falls off gymnastics apparatus, and accidental collisions. For injuries occurring during free play for grades kindergarten to six, 75 percent were the result of trips or falls, accidental collisions, blows by an object, and carelessness. Mendryk and King (78) found comparable results. Medved and Pavisec-Medved (75) demonstrated that 21.9 percent of the injuries to the elementary level were the result of bad technique. Accidental causes due to another individual accounted for 21.3 percent of the causes, and 13.1 percent of the causes were poor facilities.

Mendryk et al. (76) found for grades 7 to 12 that 55 percent of the injuries were the result of body contact with another individual or an object. Falls off of equipment or participation in a game accounted for 28

percent of the causes. Medved and Pavisec-Medved (75) reported 22.8 percent of the injuries to grades 7 to 12 were the result of bad technique. Carelessness on the behalf of another individual caused 18.7 percent of the injuries and 15.8 percent were the result of poor facilities. Whatever the specific cause, 31.8 percent of the injuries resulted from a cause connected with another individual. In descending frequency, the three main causes were bad technique, carelessness and contact with a player.

Studying individual sports for grades 7 to 12, Mendryk et al. (76) discovered 67 percent of the hockey injuries were the result of a blow by an object and body contact. Normal body contact caused 63 percent of tackle football injuries. Blows by an object ranked second. Fifty-nine percent of the injuries in wrestling were attributed to normal body contact. Ice sport injuries (75 percent) were caused mainly by body contact. Falls ranked second for causes of ice sport injuries. Sixty-nine percent of the injuries in rugby were attributed to normal body contact. For basketball 36 percent of the injuries resulted from accidental collisions or body contact. Blows by an object or falls ranked second for cause of basketball injuries. Accidental collisions and body contact caused 66 percent of the touch football injuries. Soccer injuries (33 percent) were caused primarily by collisions. A little over half of the

gymnastics injuries were caused by falls off of the equipment. Track and field injuries (37 percent) were the result of trips or falls. Softball injuries (50 percent) and volleyball injuries (40 percent) were caused by blows by objects as the main cause.

Mendryk and King (78) reported falls and accidental collisions to be the major causes of injury for grades 1 to 3. Causes of injury for grades 4 to 6 were similar to grades 1 to 3, with the addition of blows by an object and faulty landings. Major causes of injury for grades 7 to 9 were blows by an object, accidental collisions and faulty landings. For grades 10 to 12, body contact in the normal course of an activity was the major cause. Regarding causes of injury to specific body regions, the authors reported accidental collisions and blows by an object as the most frequent causes of head injury. Arm injuries were caused primarily by falls, or faulty landings off of gymnastics apparatus. Injuries to the trunk were primarily the result of faulty landings off of gymnastics apparatus. Falls, faulty landings and accidental collisions caused the majority of injuries to the leg, ankle and foot. The majority of lacerations and abrasions were the result of blows delivered by an object (65 percent), falls (52.5 percent) and accidental player collisions (49.5 percent). Collisions with objects (5 percent) and players (12.5 percent) caused the majority of concussions and contusions. Dental injuries were

caused by blows from an object (20 percent), falls (12 percent) and accidental collisions (19 percent). Causes of sprains and luxations were faulty landings (51 percent), falls (49 percent), and accidental collisions (46 percent). Faulty landings (30 percent), falls (27 percent), accidental collisions and blows by an object (25 percent collectively) caused fractures. Muscle strains were the result of faulty landings (37 percent) and collisions (19 percent).

Johnson et al. (51) reported falls to be of equal importance to all grade levels as a cause of fractures. Horseplay caused more fractures in grades 7 to 9 than did falls. Playground and gymnastics apparatus accounted for a similar fracture rate in all grades. Males accounted for the majority of fractures. The authors stated the higher rate of fractures for males was the result of a more aggressive behavior and a stronger involvement in contact sports. Basketball accounted for the highest incidence of fractures in a single sport for grades 7 to 9. For grades 10 to 12 football demonstrated the highest incidence of fractures.

Yost (116) reported that the climbing apparatus was the most common cause of injury. Accidents not involving equipment and sports equipment ranked second and third respectively for causes of injury. A total of 70 percent of the injuries reported were the result of interaction with climbing apparatus and sports equipment.

Climbing apparatus caused almost all of the dental and eye injuries, 55 percent of the fractures and 39 percent of the contusions. Sports equipment caused half of the sprains, 40 percent of the head injuries, and 35 percent of the contusions.

Dale et al. (16) observed causes of injury to be the result of unorganized play (35 percent), playground equipment (14 percent), collision with a person (9 percent) and organized play (8 percent). Almost 90 percent of the accidents occurred while alleged supervision by adults was provided.

Higdon (45) studied National Safety Council Information of 1968 and reported gymnastics and track and field injuries resulted from poor supervision, inadequate facilities, improper conditioning and poor instruction. Hockey injuries were the result of lack of equipment, broken rules, and collisions with other players or objects.

Mendryk and Dickau (77) concluded that at the junior high school level the major causes of injury were faulty equipment, poor facilities and student negligence. One year later, results demonstrated the frequency of injuries due to faulty equipment and facilities had increased, but the incidence of injuries due to negligence had decreased. At the high school level faulty equipment, facilities and negligence were major causes of injury. Data from one year later demonstrated no injuries

resulted from equipment or facilities, and a reduction of injuries due to negligence occurred.

Individual Sports Studies

Yost (116) reported causes of basketball injuries to be collisions with a player, struck by equipment, collisions with objects, improper facilities and lack of physical conditioning. Worwick (115) found comparable results to Yost, but also listed lack of protective equipment and poor skills as causes. Sesbeau (97) concluded lack of rule enforcement to be a major cause of injury.

Baseball injuries, according to Yost (116) were caused by sliding which injured the ankle, sliding and throwing which injured the shoulder, ball contact which injured the thumb and fingers, and collisions which injured the knee. Higdon (45) reported major causes of baseball injuries to be lack of supervision and inadequate playing conditions and equipment. Polk (85) reported similar results to Higdon and stated sprains were the result of running or sliding, strains the result of running or throwing, and contusions the result of collisions with an object or player.

McLatchie (72) and Koiwai (57) reported hand-to-hand combat injuries were caused by direct violence from contact with a person or object, improper technique, and inadequate facilities.

Rugby injuries, as reported by Roy (94), were primarily caused by player collisions. Lack of athletic skill, lack of conditioning, lack of proper equipment and fatigue were also observed to be important causes. Type and purchase of footwear were noted to affect the incidence of ankle and knee injuries.

Kramer (59,60) concluded the causes of soccer injuries to be due to poorly maintained playing surfaces (20 percent), fatigue due to poor training (17 percent), lack of skill (13 percent), insufficient strength (12 percent), lack of warm-up (10 percent), and unattended minor injuries, improper equipment and careless coaching (23 percent collectively). Results of the C.I.A.U. soccer study reported by Kramer (59) demonstrated that 37 percent of the injuries were the result of collisions with a player, and 19 percent were due to ground falls. Multi-cleated shoes were worn in 73 percent of the cases of injury. Similar results were recorded by Curtin and Kay (15).

Robinson (93), Dufresne (19), and Higdon (45) individually reported causes of football injuries to be the result of body contact with a player or object, repeated blows, and style of play. Alley (1) concluded poor body position and instruction to cause many football injuries. Clawson and Roser (9) found major causes of injury to be lack of proper coaching in skills, and conditioning methods. Separate studies by Kraus, Anderson and Mueller

(61), and Robey, Blyth and Mueller (92), demonstrated poor quality equipment, poor fit of equipment, and poor quality of the playing field were the major causes of injury. Godshall (33) concluded similar results to Robinson (93) but further stated the rules should be set to the type and quality of equipment and player to influence causes of injury. Mismatching of participants and lack of rule enforcement were also important causes.

For hockey, Wilson et al. (113) demonstrated the majority of facial injuries were the result of the puck for 7 to 17 year olds. The stick ranked second for cause of injury. Body contact, inadequate officiating, inadequate equipment, and inadequate enforcement of rules of play were also causes of injury, but to a lesser degree. Hussey (49), Worwick (115), Yost (116), Pashby et al. (84), Hayes (40), and Reeves and Mendryk (88) separately reported the stick to be the leading cause of facial injuries. The majority of head and dental injuries were the result of improper equipment, and collisions. Generally, the stick, puck and body contact were reported as major causes of hockey injuries.

Potential causes of ski injuries were reported in the literature as multiple and varied.

Westlin (111, 112) attributed the causes of injury to be due to falls (95 percent) and the remainder to collisions. Falls causing rotational forces resulted in the majority of the lower limb injuries. The type of

equipment (boots and bindings) affected the nature, severity and rate of injury. Johnson, Pope and Ettinger (51) found similar results and reported over 50 percent of the ski injuries were caused by maladjusted equipment. Young et al. (117) reported causes of injury to be fatigue, loss of control, poor technique, and poor coordination. Westlin (112) concluded results comparable to Young et al. (117) and observed 32 percent of the injuries to be self-incurred, 28 percent to be caused by weather conditions, and 21 percent to be the result of slope conditions. Eriksson (24) reported similar results to Westlin (112). Johnson, Pope and Ettinger (51) concluded the level of ability or expertise of the skier influenced the frequency of injury. The young skier of up to eighteen years of age increased the possibility of injury occurrence as reported by Gutman, Weisbuck and Wolf (36). Richards (89) studied skiers in Alberta. The immediate cause was a torsion injury resulting from a fall. The level of expertise or experience varied the accident rate. A beginner or novice skier was found to be more prone to injury since the lack of control was reduced, collision-with-hazards potential was increased, and the ability to handle slope and weather conditions was reduced. Lack of skill and lack of physical conditioning, predisposing the skier to early fatigue, were causal factors. Twenty-eight percent of the injuries were the result of the skier skiing beyond the level of

ability. Twenty-three percent were the result of the skier on terrain beyond the level of ability, and 14 percent were the result of collisions with obstacles. Richards summarized the four major causes of ski injuries to be:

1. loss of control resulting from improper conditioning, experience and faulty technique, fatigue or excessive speed
2. dangerous skiing conditions including ruts, obstacles, moguls, and changes in slope conditions
3. weather conditions
4. faulty or improperly adjusted equipment.

Summary of Review of Literature

Incidence of Injury

As the grade level increased, so did the injury rate, and as age level increased, so did the incidence of injury (76,77,78).

Free play, gymnastics and unorganized activity accounted for the majority of injuries in the elementary grades. Peak times of day for injury were during noon hour, morning recess and afternoon recess. Age eleven appeared to be a peak year for injury, and males were injured with a greater frequency than females. Some authors (9,16,82,99,101) found grade two to be a peak grade. The frequency of injury was higher in the elementary grades due to a lack of co-ordination and musculoskeletal skills. Athletes of thirteen years or younger were usually injured less since the velocity of impact and level of competition were less, which contradicted earlier reports. The discrepancy may be the result of methods of assessment and recording of data, and the type and seriousness of injury reported.

For junior high school, gymnastics, track and field, volleyball and basketball accounted for the majority of injuries. In high school the majority of injuries were accounted for by gymnastics, track and field, basketball and football. For grades seven to twelve, 12:00 p.m. to 1:00 p.m. and after 4:00 p.m. were frequent

periods for injury, and coincided with intramural and interscholastic participation respectively. At the junior high school and high school levels fourteen years of age for males and thirteen years of age for females were peak years for injury. No significant differences of incidence of injury between the sexes were noted if the male-oriented sports were eliminated. Grade seven had the highest incidence of injury, while a decrement occurred for grades eight and nine. The rate of injury increased at the grade ten level.

The highest rate of injury for all grades occurred in physical education classes. Contact sports yielded the highest incidence of injury for grades nine to eleven (ages fourteen to sixteen) and intramurals yielded the highest incidence of injury for grades seven to ten (ages twelve to fifteen). Intramurals yielded fewer and less severe injuries than interscholastic competition. Formal competition maintained a higher incidence rate than did practices.

Nature of Injury

At the elementary level, injuries to the head, face and teeth predominated. Injuries to the ankles and fingers were second in frequency. Contusions, especially to the knee and ankle, were the most common type of injury, followed by lacerations, dental attrition and fractures. For the elementary grades, the incidence of

fractures coincided with increases in grade levels.

Injuries to the ankle, hand and knee were most frequent to junior high school athletes, followed by injuries to the face and hands. Contusions to all body areas were followed by sprains, fractures and strains. Fewer incidences of dental attrition were noted. Grades seven to nine maintained the highest incidence of fractures.

At the high school level, the ankle, hand and knee were most frequently injured, followed by the face and back. Sprains, fractures and strains were the most frequent types of injury. Dental attrition was greatly reduced over elementary level incidences.

Generally, with respect to types of injury, the head was characterized by lacerations, and the hands and fingers were characterized by sprains and fractures. The foot, ankle and leg were characterized by sprains and fractures.

The most frequent injuries in football occurred to the ankle and knee. The injuries were primarily sprains. Injuries to the feet, hands and fingers were next for frequency and the injuries were usually sprains, fractures and contusions. Overall, sprains were followed by strains, thirdly by contusions and lastly by fractures. The least protected areas sustained the most injuries. The most predominant injury to ages twelve and thirteen were contusions to all body areas. The most frequent

injuries to ages fourteen and fifteen were knee and ankle sprains, followed by contusions to the thighs and back, and lastly by fractures of the ankles and fingers. Shoulder and finger dislocations were most common to the sixteen and seventeen year old age range.

In touch football, the face and head were the most frequently injured body areas. The hand, knee and shoulder followed in the respective order. Sprains were most frequent, followed in frequency by fractures, contusions and lacerations.

In basketball, the incidence of injury to the foot and ankle was similar to the incidence of injury to the face and head. Hand injuries followed next. Sprains occurred most frequently. Fractures were the second most common type of injury.

In volleyball, injuries to the hand were most frequent. Foot and ankle injuries followed hand injuries in frequency. Sprains were the most common type of injury. Strains, fractures and lacerations followed sprains for incidence.

In soccer, foot and ankle injuries were most common. Injuries to the knee, face and hand were second for incidence of injury. Abrasions and contusions were common to all body areas. Sprains and strains surfaced as the most common injuries and were followed by contusions, lacerations, dental attrition and fractures.

The foot and ankle, face and head, hand and back

characterized the nature of gymnastics injuries. Sprains, strains and fractures predominated.

In track and field, injuries frequently sustained were to the foot and ankle, secondly the face, hand and head, and thirdly the knee. Strains, abrasions and lacerations were most frequent and were followed in frequency by contusions and sprains.

Baseball was characterized by injuries predominantly to the head and face, and secondly to the foot, ankle and hand. Fractures were followed by lacerations and sprains for frequency of types of injury.

Over half of the injuries in ice hockey were to the head and consisted primarily of lacerations, abrasions and dental injuries. Head, lower leg, hands, fingers and lower arm were injured in descending frequency. Lacerations occurred most frequently, and were followed by strains, sprains and fractures. Mouth lacerations were most frequent to ages nine and ten, dental injuries for ages eleven and twelve, mouth lacerations and shoulder injuries for ages thirteen and fourteen, hand fractures and concussions for ages fifteen and sixteen, and nasal fractures for ages seventeen and eighteen.

Injuries to the lower extremity were dominant in skiing. Knees and ankles accounted for the majority of the injuries. For age fifteen or younger, fractures particularly of the tibia and fibula were common, whereas

to the older skier knee sprains and secondly fractures of the leg were predominant.

In rugby head and neck injuries predominated. Injuries to the shoulders and knees followed. Fractures and lacerations were high in frequency.

Intramural sports were characterized by certain injuries. Types of injuries sustained followed the patterns of the interscholastic and league injuries. Sprains and strains were most frequent, followed by contusions. The knee, ankle, shoulders and fingers were most frequently injured in the form of sprains.

Generally, in the adolescent athlete joint regions were injured the most frequently, and particularly the knee. Certain body areas sustained certain types of injury. The ankle sustained sprains, the lower leg sustained contusions and strains, the knee sustained sprains, the shoulder sustained sprains, and the wrist and hand sustained fractures. Sprains were a common injury to grades seven to ten, fractures for grades seven, eight and ten, open wounds for grades seven to nine, and strains for grades nine and ten.

Causes of Injury

Causes of injury were listed, in general terms, to include improper coaching, poor quality instruction of skills, inadequate facilities, inadequate or lack of equipment, poor physical conditioning causing fatigue,

lack of adequate officiating, supervision or rule enforcement, insufficient skill levels, and performance beyond the individual's capabilities, and unsafe behavior and attitudes of the participant. Mismatching of participants and types of equipment employed were also causal factors.

Body contact, collisions with other players or objects, and falls caused many injuries. Injuries frequently occurred on the climbing apparatus and sports equipment.

For kindergarten to grade six, causes were falls or trips, collisions between participants, blows delivered by objects, loss of balance on the apparatus, and carelessness.

For grades seven to twelve, blows by an object, body contact, falls off of equipment, faulty facilities, faulty equipment, participant negligence, and the nature of the sport were causes.

Causes of injury to females were similar to their male counterparts.

Injuries resulting in specific sports were often the result of the nature of the sport and the demands required by the sport, in combination with the aforementioned general causes.

CHAPTER III

METHODS AND PROCEDURE

Methods

An investigation of the incidence, nature and causes of sports injuries occurring in unorganized and organized activity was accomplished through application of the survey technique.

The injury report form used in the study is included in Appendix A. Instructions (available from the Faculty of Physical Education and Recreation, University of Alberta) regarding the correct procedure for the completion of the forms, and a description of terms used were provided with the forms placed in all the public schools of Edmonton, Alberta.

The academic years of 1974-75 and 1975-76 were selected for study since the years represented the most recently completed academic terms. The total population sample for the aforementioned years consisted of 142,177 registered students. The study involved grades kindergarten to 12 inclusive, of all the public schools in Edmonton, Alberta. The total sample of injured students consisted of 3,653 males and females.

Once an injury occurred and was reported, the injury report form was completed by the coach, teacher or physical educator. The form was completed at the time of injury. Initial evaluation of the injury was made at the

time that the injury was recorded. Where necessary, referral was made to a physician. Through direct contact with the physician or through conveyance by the injured athlete, further information about the injury was provided and recorded.

Three copies of the form were sent to the Edmonton Public School Board. One copy of the report form was retained by the school where the injury occurred.

Procedure

Arrangements for the collection of the forms and statistical analysis were then arranged through contact with Dr. Harry Hohol and Dr. Tom Blowers of the Edmonton Public School Board.

An S.P.S.S. computer program was designed to yield incidence totals and possible causal relationships. Selected three-way cross-tabulations of individual and grouped grades were run and analysed.

Interpretation of the results, and suggestive measures and recommendations were forthcoming.

A full computer print-out of the results may be obtained from the Faculty of Physical Education and Recreation, University of Alberta, on request.

CHAPTER IV

RESULTS AND DISCUSSION

Results

Tables of the results are found in Appendicies B (grades kindergarten to 6), C (grades 7 to 9) and D (grades 10 to 12).

Grades Kindergarten to 6

Males accounted for 61.9 percent of the injuries and accounted for the majority of injuries in each individual activity. Games were the only exception, and the injury rate for the sexes was almost equal. Females were observed to reach a high rate of injury approximately one year earlier than did males, and the peak age varied according to the activity.

The playing field accounted for 53.4 percent of the injuries. On the playing field, the frequent probable causes of injury were accidental collisions and normal body contact. The majority of injuries that occurred on the playing field were accounted for by grades 5 to 7. The gymnasium (20.9 percent) ranked second, and play apparatus (11.7 percent) ranked third for numbers injured.

Peak times of day for injury were observed to be 2:00-2:59 p.m. (afternoon recess), 10:00-10:59 a.m. (morning recess), and 12:00-12:59 p.m. (lunchtime),

respectively. For kindergarten, grades one and six, the times of day most common for injury were morning and afternoon recess respectively. Grades 2 to 5 followed the overall pattern of times of day frequent for injury.

The body region injured most frequently was the head (25 percent). The majority of head injuries occurred during recess. A laceration was the type of injury frequently observed to the head. The face was the body region injured second most frequently. Facial injuries primarily consisted of lacerations, and occurred at recess. The body region injured third for rate of injury was the tooth (11.6 percent), and dental attrition commonly occurred at recess.

The most common type of injury was a laceration at 25.8 percent. Contusions ranked second and accounted for 17.1 percent of the injuries. Of all types of injury, 18.7 percent consisted of lacerations to males. For females, the frequent types of injury in descending order of incidence were contusions (24.6 percent), lacerations (20.6 percent) and fractures (11.3 percent). For males, the frequent types of injury in descending order of incidence were lacerations (33.6 percent), contusions (15.5 percent) and dental attrition (12.7 percent).

The major probable direct cause of injury was a trip or fall accounting for 27.3 percent of the causes of injury. Accidental collisions (20.5 percent) ranked second, and blows by an object (17.4 percent) ranked

third. The majority of falls or trips, obstructions, accidental collisions and normal body contact occurred on the playing field. For grades kindergarten to 3, the majority of falls or trips occurred on the play apparatus, but for grades 4 to 6 the gymnasium accounted for a higher rate of trips or falls. Injuries resulting from carelessness were evenly divided between the classroom and the playing field. As the grade level increased, injuries caused by falls or trips, accidental collisions, blows by an object, normal body contact and carelessness also increased. Kindergarten students were injured most frequently from falls or trips. Grades one, three and five were frequently injured by obstructions, and grades two and six were injured by accidental collisions. The majority of injuries for all grades occurred during activity while on the playing field.

Free play (54.8 percent) was the activity with the highest injury rate. Organized activity accounted for 23.5 percent, and games accounted for 14.5 percent of the injuries. For grades kindergarten, one and three, free play was most hazardous. Organized activity was most injurious to students of grades two and four. For grades five and six students, games and gymnastics were the most hazardous activities.

Activities

Free Play: Males accounted for 65.6 percent of the

injuries. As the grade level increased, the spread in injury rate for the sexes decreased. The injury rate for free play increased concommitantly with increasing grade level, and peaked in grade six. Of all free play injuries, 10.9 percent were accounted for by grade six males. The major cause of injury was a fall or trip (27.3 percent). Accidental collisions ranked second at 25.4 percent, and blows by an object ranked third at 14 percent.

The majority of all probable direct causes for the elementary grades occurred in free play. Free play was the activity with the highest overall incidence of injury caused by blows by an object. Falls or trips were common causes of injury in free play to males, and falls or trips were common causes of injury in free play to females.

Organized Activity: Males accounted for 60.8 percent of the injuries. Grade four was the individual grade demonstrating the highest injury rate. Of all injuries in organized activity, 10.6 percent occurred to grade six males. Males peaked for injury in grade six, but females were observed to peak in grade four. The major cause of injury was a trip or fall at 26 percent. The second

most frequent cause was an accidental collision (21.5 percent), and blows by an object (20.7 percent) placed third for cause of injury. With the exception of blows by an object and falls or trips on the apparatus, the second highest incidence of injury for all causes occurred during organized activity.

Games: The ratio of injury to the sexes was approximately 1:1, but females accounted for 50.6 percent. Grades 4 to 6 accounted for 60.5 percent of all injuries in games. Males peaked for injury in grade six and females peaked in grade five. Of all games injuries, 28.3 percent occurred to grades five and six males.

Games was the activity with the highest rate of injury caused by blows by an object to females. As grade level increased, the injury rate also increased, and the spread in incidence of injury to the sexes narrowed as grade level increased. The frequent cause of injury was a blow by an object at 35.5 percent. Trips or falls at 27.1 percent ranked second and accidental collisions at 21.9 percent ranked third.

Games was the activity accounting for the second highest rate of injuries caused by blows by an object and over-exertion.

Gymnastics: Males accounted for 59.2 percent of the injuries. Grades 5 to 6 accounted for 42.8 percent of all gymnastics injuries. Grade six was the individual grade with the highest rate for injury. The injury rate was observed to increase concomitantly with the increasing grade level. Males peaked for injury in grade six, and females in grade five. The major cause of injury was a fall on the apparatus (50.7 percent). Falls or trips (16 percent) ranked second, and blows by an object (10.7 percent) ranked third for cause of injury.

Gymnastics accounted for the second highest rate of injury due to falls on the apparatus, and over-exertion.

Dance: Injuries were few, and females accounted for 57.1 percent of the injuries. The most frequent cause was a fall involving apparatus at 33.3 percent.

Program Phase

Recess: accounted for 40.4 percent of the injuries. The head was the most frequently injured body region at 26.6 percent. The teeth (14.6 percent) ranked second and the face (14.2 percent) ranked third. Falls or trips (27.2 percent) were the common cause of injury and frequently caused lacerations

Accidental collisions (26.8 percent) causing dental attrition primarily, ranked second. Blows by an object (15 percent) primarily causing lacerations, ranked third.

The most frequent type of injury was a laceration (25.3 percent) and occurred commonly to the head. Contusions (18.7 percent) commonly to the head, ranked second. Dental attrition (14.4 percent) and fractures (14.4 percent) commonly to the upper limb, ranked third.

Before/After School: accounted for 25 percent of the injuries. The head was the most frequently injured body region at 30 percent. The face (15.8 percent) ranked second and the teeth (11.1 percent) ranked third for incidence of injury. The frequent probable direct cause was a fall or trip (28.9 percent) causing lacerations primarily. Accidental collisions (18 percent) commonly causing dental attrition, ranked second. Carelessness (15.6 percent) commonly causing lacerations, ranked third.

Lacerations were the common type of injury at 33.9 percent and commonly occurred to the head and face. Contusions (16.1 percent) were frequent to the head. Fractures (11.1 percent) were frequent to the upper limb.

Physical Education: accounted for 23.7 percent of the injuries. The head accounted for 21.8 percent of the injuries. Injuries to the face (12.7 percent) ranked second, and dental attrition (8.3 percent) ranked third.

The common cause of injury was a fall or trip (27.7 percent) and primarily caused contusions. Blows by an object at 24.1 percent, commonly caused lacerations and contusions. Accidental collisions at 17.8 percent commonly caused lacerations.

The frequent type of injury noted was a contusion (21.6 percent) and commonly occurred to the head. Lacerations (18.8 percent) were common to the face. Fractures (13 percent) were common to the upper limb and sprains (12.7 percent) were common to the ankle.

Classroom: accounted for 10.3 percent of the injuries. The face (23.5 percent), head (19.9 percent) and finger (18.1 percent) were the body regions commonly injured.

Carelessness (35.9 percent) was the major cause of injury and primarily caused lacerations. Falls or trips (27.3 percent) commonly caused lacerations, as did blows by an object (18.8 percent).

Lacerations, particularly to the face, were the

commonest type of injury, at 51.4 percent. Contusions, commonly to the head, accounted for 16.9 percent of the injuries.

Intramurals: accounted for only 2.4 percent of the injuries. Facial injuries (23.7 percent) were most frequent, and dental attrition (18.4 percent) ranked second. Blows by an object (40 percent) commonly caused lacerations and dental attrition. Falls or trips (17.1 percent) frequently causing lacerations and strains, ranked second. Falls on the apparatus (14.3 percent) frequently causing concussions, ranked third.

Types of injury observed were contusions (27.3 percent), often to the face and nose, dental attrition (18.2 percent) and lacerations (15.2 percent) frequently to the head and face.

Interscholastics: accounted for 1.5 percent of the injuries. Facial injuries at 16.7 percent, nasal injuries at 12.5 percent, and dental attrition at 12.5 percent were frequently observed.

Blows by an object (33.3 percent) commonly caused lacerations. Accidental collisions (28.6 percent) commonly causing dental attrition, ranked second. Lacerations, contusions and fractures individually accounted for 16.7 percent of the types of injury. Lacerations were common to the face, finger and

knee. Contusions were frequent to the lower limb and face. Fractures were common to the elbow/forearm.

Grades 7 to 9

Males accounted for 52.9 percent of the injuries. The program phase with the highest injury rate was physical education at 51.5 percent. The classroom accounted for 22.7 percent of the injuries.

Over one-half of the injuries to grades 7 to 9, collectively and individually, occurred in the gymnasium. Grade nine was the individual grade accounting for the majority of injuries which occurred in the gymnasium. In the gymnasium the probable direct causes of injury most frequent to grade seven were over-exertion and falls from the apparatus. Students in grades 8 to 9 sustained injuries in the gymnasium, often as a result of blows by an object. On the playing field, obstruction was the major cause of injury to those in grades 7 to 8. Normal body contact was the major cause of injury on the playing field to grade nine students. The majority of injuries in the classroom occurred most frequently to those in grades 7 to 8, and were mainly caused by carelessness.

Generally, 2:00-2:59 p.m. followed by 10:00-10:59 a.m. were the times of day with the highest injury rates. The peak time of day for injuries in physical education was 9:00-10:59 a.m. Intramural injuries occurred most

frequently to grades 7 to 9 of grades 7 to 12, and were most frequent during 12:00-12:59 p.m. All interscholastic injuries occurred after 4:00 p.m. The majority of injuries in the classroom for grades seven and eight occurred from 1:00-2:59 p.m.

The finger (19.2 percent) was the most frequently injured body region. The head ranked second and accounted for 11.3 percent of the injuries. The ankle (10.7 percent) ranked third for incidence of injury. For males, the body regions injured frequently were the finger (19.2 percent), sustaining lacerations primarily, and the head (12.8 percent), most frequently sustaining lacerations. For females, the finger (15.4 percent) commonly sustained lacerations, and the ankle (14.6 percent) commonly sustained sprains. Overall, injuries to the upper limb, which included the shoulders, arm, elbow, forearm, wrist, hand and fingers, accounted for 60.6 percent of the injuries.

A laceration (22 percent) was the common type of injury. Contusions (18 percent) ranked second and sprains (15.3 percent) ranked third. For males, the most frequent type of injury was a laceration (28.3 percent), which occurred commonly to the hand. Contusions (15.3 percent) frequently to the buttocks/groin and knee ranked second. For females, contusions (20.6 percent), commonly to the buttocks/groin, nose and knee, were the frequent types of injury. Sprains (20.2 percent) frequently to

the ankle, ranked second.

The major cause of injury to grade seven students was carelessness. The number of injuries from carelessness decreased to grade twelve. Students in grades eight and nine were injured most frequently from blows by an object. Grade nine accounted for the highest injury rate of grades 7 to 12 for falls from the apparatus. Grades seven and nine accounted for the majority of injuries due to normal body contact, of grades 7 to 12 inclusive. Grade nine was the individual grade with the highest injury rate. With the exception of carelessness, grade nine accounted for the majority of all probable causes of injury. As grade level increased toward grade twelve, the rate of injury caused by falls or trips remained fairly constant. From grades kindergarten to 9, the injury rate due to normal body contact and blows by an object increased. Injuries caused by falls from the apparatus increased concomitantly with increasing grade level of grades 7 to 9. Injuries caused by accidental collisions decreased as grade level increased from grades 7 to 12.

The category of 'other', which included class changes, industrial arts, home economics, drama, school buses, circle ball and fighting, was the activity with the highest incidence of injury (20.5 percent). Miscellaneous indoor activities comprised of dodge ball and non-instructional activities ranked second. Basketball

(11.5 percent) was the structured activity with the highest injury rate. Track and field and gymnastics apparatus each accounted for 10 percent of the injuries.

In grades seven and nine, females were injured at a slightly higher rate in the majority of sports. In grade eight, the number of sports dominated for injury by males was equivalent to the number of sports dominated for injury by females. Females were noted to peak for injury approximately one year earlier than males, and for grades 7 to 12 the peak was fourteen years of age.

Activities

Aquatics: accounted for 0.6 percent of the injuries.
The finger and lower leg accounted for 80 percent of the body regions injured.
Sixty percent of all injuries were lacerations.
Probable causes of injury frequent in aquatics were evenly divided between falls or trips, falls from the apparatus and accidental collisions.
Forty percent of the injuries occurred in physical education and 40 percent occurred before/after school.

Basketball: accounted for 11.5 percent of the injuries.
The finger (35.4 percent) and ankle (24 percent) were commonly injured body regions.
Major types of injury were sprains (34.9 percent)

and contusions (22.1 percent).

Blows by an object were the frequent cause of injury at 43.8 percent.

The program phase that accounted for the highest injury rate was physical education (68.4 percent).

Bordenball: accounted for 1.1 percent of the injuries.

One-third of all injuries occurred to two or more body regions.

Contusions (37.5 percent) were the commonest type of injury.

The most frequent probable direct cause was an accidental collision (50 percent).

The program phase with the highest injury rate was physical education (77.8 percent).

Dance: accounted for 0.6 percent of the injuries. The ankle accounted for 40 percent of the body regions injured.

Sprains were the common type of injury (75 percent).

Blows by an object caused 60 percent of the injuries, and all injuries occurred in physical education.

Field Hockey: accounted for 1.2 percent of the injuries.

The body region most frequently injured was the

head (22.2 percent).

Contusions accounted for 60 percent of all types of injury.

Blows by an object caused 77.8 percent of the injuries, and all injuries occurred in physical education.

Tackle Football: accounted for 0.7 percent of the injuries. Injuries to the body regions were well-distributed.

Contusions (33.3 percent) were the common type of injury.

Normal body contact caused 83.3 percent of the injuries.

Before/after school accounted for 33.3 percent of the injuries.

Touch Football: accounted for 3.4 percent of the injuries. Body regions most frequently injured were the finger (20 percent) and the knee (20 percent). Sprains (28.6 percent), lacerations (17.9 percent) and contusions (17.9 percent) were frequent types of injury.

Blows by an object (28.6 percent) and accidental collisions (25 percent) caused the majority of injuries.

Approximately 61 percent of the injuries occurred in physical education.

Gymnastics Apparatus: accounted for 10 percent of the injuries. The body regions frequently injured were the ankle (12.2 percent), the feet (11 percent) and the wrist (11 percent).

Contusions accounted for 22.1 percent, and sprains accounted for 19.5 percent of the types of injury.

Falls on the apparatus accounted for 61.1 percent of the injuries.

Physical education accounted for 85.5 percent of the injuries.

Gymnastics Tumbling: accounted for 6.9 percent of the injuries. Necks (23.2 percent) and backs (19.6 percent) were frequently injured regions.

The commonest type of injury observed was a strain (38 percent).

Over-exertion caused 36.7 percent of the injuries.

Physical education accounted for 84.2 percent of the injuries.

Hockey: accounted for 1.2 percent of the injuries. The head (40 percent) and face (30 percent) were commonly injured.

Lacerations and contusions accounted for 57.2 percent of the injuries.

Blows by an object caused 60 percent of the injuries.

Nine-tenths of the hockey injuries occurred in physical education.

Ice Sports: accounted for 1.9 percent of the injuries. The head (37.5 percent) was the frequently injured body region. The face (25 percent) ranked second.

Lacerations were the common type of injury at 30.8 percent.

Trips or falls caused 50 percent of the injuries, and physical education accounted for all of the injuries.

Racquet Sports: accounted for 1.2 percent of the injuries. The head and face accounted for 55.5 percent of the injuries.

The frequent type of injury was a contusion at 33.3 percent.

All injuries were caused from a blow by an object.

Physical education accounted for 60 percent of the injuries.

Soccer: accounted for 6 percent of the injuries. The ankle accounted for 20.8 percent of the injuries to body regions. The lower leg (10.4 percent) ranked second.

Contusions (31.1 percent), sprains (31.1 percent) and fractures (31.1 percent) were the

common types of injury.

Accidental collisions caused 47.8 percent of the injuries.

Physical education accounted for 84 percent of the injuries.

Softball: accounted for 2 percent of the injuries. The nose and face (41.1 percent) were most commonly injured.

Contusions accounted for 23.5 percent of the types of injury.

Blows by an object caused 62.5 percent of the injuries, and 81.3 percent of the injuries occurred in physical education.

Track and Field: accounted for 10 percent of the injuries. Ankles (18.3 percent) and backs (17.1 percent) were frequently injured.

Sprains (24.1 percent) were the commonest type of injury, followed secondly by contusions (19 percent).

Falls on the apparatus caused 34.2 percent of the injuries.

Physical education accounted for 74.7 percent of the injuries.

Volleyball: accounted for 7.5 percent of the injuries. The finger (24.6 percent) was the most frequently

injured body region. The ankle (16.4 percent) ranked second.

Sprains accounted for 32.8 percent of the types of injury.

Blows by an object caused 45.1 percent of the injuries.

Physical education accounted for 77.4 percent of the injuries.

Wrestling: accounted for less than 5 percent of the injuries. Shoulders accounted for 25 percent of the body regions injured. Knees (12.5 percent) ranked second.

Common injuries were sprains (21.1 percent), contusions (19.4 percent), strains (19.4 percent) and fractures (18.4 percent).

Normal body contact caused 71.4 percent of the injuries.

Physical education accounted for 68.4 percent of the injuries.

Miscellaneous Indoor Activities: accounted for approximately 19 percent of the injuries. Body regions frequently injured were the head (17.7 percent) and the finger (15.2 percent).

Lacerations (35 percent) were the commonest type of injury.

Carelessness caused 29.9 percent, and blows by an

object caused 26.1 percent of the injuries. The program phase highest for injury was physical education (44.2 percent).

Miscellaneous Outdoor Activities: accounted for 8.5 percent of the injuries. Injuries to the face, elbow/forearm and finger accounted for 31.2 percent of the injured body regions.

Lacerations accounted for 31 percent of the types of injury.

Falls or trips caused 24.5 percent of injuries. Before/after school and physical education accounted for 78.6 percent of the injuries.

Skiing: accounted for 2.3 percent of the injuries. The finger (17.4 percent), knee (17.4 percent) and lower leg (17.4 percent) were frequently injured.

Fractures accounted for one-half of the types of injury.

Falls or trips caused 50 percent of the injuries, and 94.4 percent of the injuries occurred during physical education.

Program Phases

Physical Education: In physical education 11.6 percent of the injuries occurred on gymnastics apparatus, and 54.9 percent of these injuries were the result of falls on the apparatus. Miscellaneous indoor

activities accounted for 11.3 percent, and resulted primarily from a blow by an object (31.9 percent).

The overall cause of injury was a blow by an object (20.3 percent). The majority of injuries caused from a blow by an object occurred most frequently in basketball.

The major types of injury were sprains (21.3 percent) and contusions (18.8 percent).

Physical education accounted for 51.6 percent of the injuries of all the program phases. Of all physical education injuries, 6.4 percent were the result of falls on the apparatus during gymnastics apparatus participation.

Intramurals: accounted for 5.4 percent of the injuries. Miscellaneous indoor activities accounted for 17.2 percent of intramural injuries, and were frequently caused by a blow by an object (27.3 percent).

Types of injuries commonly noted were contusions (25.5 percent) and fractures (20 percent).

A blow by an object caused 21.9 percent of the injuries. Approximately 64 percent of the injuries caused by a blow by an object occurred in basketball, volleyball and miscellaneous indoor activities.

Of all injuries in intramurals, 7.8 percent resulted from normal body contact in wrestling.

Interscholastics: accounted for 4.7 percent of the injuries. Basketball accounted for 39.3 percent of the injuries, and a blow by an object caused 27.3 percent of the basketball injuries.

Types of injury frequently observed were sprains (24.5 percent) and fractures (21.8 percent).

Blows by an object caused 21.4 percent of the injuries, and one-half of the incidents occurred in basketball.

Of all interscholastics injuries, 10.7 percent occurred from a blow by an object in basketball, 10.7 percent from normal body contact in wrestling, and 8.9 percent from accidental collisions in basketball.

Recess: accounted for 1.4 percent of the injuries.

Sports accounting for injuries were few but evenly distributed.

Major causes of injury, accounting for 70.5 percent of the causes of injury, were falls or trips, blows by an object and normal body contact.

Contusions and fractures accounted for 46.2 percent of the types of injury.

Before/After School: accounted for 14.2 percent of the

injuries. The activity highest for injury was miscellaneous indoor activities (21.4 percent) and the frequent cause was carelessness (44.4 percent). Miscellaneous outdoor activities accounted for 18.5 percent, and 19.4 percent of these were the result of falls or trips.

Types of injury frequently observed were lacerations (25.5 percent) and contusions (19.5 percent).

Carelessness (20.8 percent) was the major cause of injury. Of all injuries occurring before/after school, 9.5 percent were the result of carelessness, and occurred indoors.

Classroom: accounted for 22.7 percent of the injuries.

Miscellaneous indoor activities accounted for 14.6 percent.

Lacerations and abrasions accounted for 69.3 percent of the types of injury.

Carelessness (44.4 percent) was the major cause of injury. Of all classroom injuries, 5.6 percent were the result of carelessness indoors.

Grades 10 to 12

Males accounted for 64.9 percent of the injuries. The program phase with the highest injury rate was physical education (49.2 percent). The classroom (24.5

percent) ranked second.

The gymnasium was the facility area with the highest injury rate overall, and for the individual grades of ten and eleven. For grade twelve, the classroom was the facility area highest for injury. In the gymnasium the major cause of injury to grade ten was a blow by an object. For grade eleven the major cause of injury was an obstruction, and for grade twelve a fall on the apparatus was the major cause of injury. On the playing field grade ten students were injured most frequently by an obstruction. Normal body contact was the frequent cause of injury to grades eleven and twelve students. Carelessness was the major cause of injury in the classroom for all grades.

Times of day for injury varied. Grades ten and eleven were injured frequently during 2:00-2:59 p.m. Injuries to grade twelve were well-distributed throughout the day. In grades ten and eleven, 8:00-9:59 a.m. and 2:00-2:59 p.m. were the frequent times of day for injury in physical education. Physical education was not compulsory for grades eleven and twelve, explaining the low and even distribution of injuries. Interscholastic injuries occurred most frequently during 4:00-6:00 p.m. with 4:00-4:59 p.m. observed as the hour highest for injury. Injuries in the classroom peaked during 9:00-10:59 a.m. Intramural injuries occurred most frequently during 12:00-12:59 p.m.

The body regions injured most frequently were the finger (15.6 percent), the ankle (11.2 percent) and the head (9.7 percent). Overall, the upper limb, previously described in the analysis of grades 7 to 9, accounted for 57.1 percent of the limb injuries. For males, body regions frequently injured were the finger (14.9 percent), the ankle (10.3 percent) and the head (9.7 percent). Injuries to the finger and head were primarily lacerations, and to the ankle were frequently sprains. For females, body regions frequently injured were the finger (16.9 percent), the ankle (12.7 percent) and the face (10.1 percent). Finger and facial injuries were frequently lacerations, and ankle injuries were usually sprains.

Overall, frequent types of injury were lacerations at 25.3 percent and fractures at 12.1 percent. For males, common types of injury were lacerations (29.1 percent) usually to the finger, and fractures (18.8 percent) usually to the upper limb. For females, common types of injury were sprains (22.3 percent) frequently to the ankle, contusions (18.9 percent) commonly to the head and face, and lacerations (18.3 percent) usually to the finger.

For grades 10 to 12, the major cause of injury was a blow by an object. Carelessness ranked second. For the individual grades, the major cause of injury to grades ten and eleven students was a blow by an object,

and occurred most frequently in the gymnasium. For grade twelve, carelessness, frequently occurring in the classroom, was the major cause of injury. Overall, the injury rate decreased from grades 10 to 12. The gymnasium was the facility area which accounted for the majority of the causes of injury for grades 7 to 12. Generally, injuries caused by obstruction were most frequent on the playing field, and injuries resulting from carelessness were most frequent in the classroom. For grades 7 to 10, the majority of injuries due to normal body contact occurred in the gymnasium, but for grades 11 to 12 injuries caused by normal body contact were more frequent on the field. Accidental collisions for grades 7 to 10 occurred frequently on the field, but for grades 11 to 12 accidental collisions were more frequent in the gymnasium. As grade level increased to grade twelve, the injury rate due to all causes of injury decreased. Accidental collisions were more frequent for causes of injury in grade ten than normal body contact. Normal body contact caused more injuries than accidental collisions for grades eleven and twelve.

Miscellaneous indoor activities accounted for 14.9 percent of the injuries. Miscellaneous outdoor activities accounted for 10.6 percent of the injuries. For structured activities, basketball was highest at 10.4 percent.

Activities

Aquatics: accounted for 3.5 percent of the injuries.
The face accounted for 28.6 percent of the injuries. The head (21.4 percent) and foot (21.4 percent) ranked second for incidence of injury.
Lacerations (63.6 percent) were the commonest type of injury.
The major cause of injury was an accidental collision.
Physical education accounted for 73.3 percent of the injuries.

Basketball: accounted for 10.4 percent of the injuries.
The ankle represented 36.6 percent of the injuries, and the finger ranked second (14.6 percent).
Sprains were the frequent type of injury (43.2 percent).
Causes of injury were falls or trips (26.8 percent), accidental collisions (24.3 percent) and blows by an object (24.3 percent).
Physical education accounted for 58.5 percent of the injuries.

Bordenball: accounted for 0.3 percent of the injuries.
All the injuries were nosebleeds caused by accidental collisions, and all occurred in physical

education.

Dance: accounted for 0.3 percent of the injuries. All injuries were fractures to the foot and occurred during physical education.

Field Hockey: accounted for 2 percent of the injuries. The head and nose accounted for one-half of the injuries.

Sprains and strains accounted for 57.2 percent of the injuries.

Blows by an object caused 57.1 percent of the injuries, and all injuries occurred in physical education.

Tackle Football: accounted for 6.6 percent of the injuries. The knee accounted for 23.1 percent of the injuries to the various body regions. Injuries to the teeth (11.5 percent), shoulder (11.5 percent) and two or more body regions (11.5 percent) ranked second.

Fractures (36 percent) and strains (32 percent) were most frequent.

Normal body contact caused 68 percent of the injuries, and 96.2 percent occurred in interscholastics.

Touch Football: accounted for approximately 6 percent of the injuries. The head (26.1 percent) and

finger (21.7 percent) were frequently injured body regions.

Frequent types of injury were contusions (23.8 percent), fractures (19 percent) and concussions (19 percent).

Accidental collisions (50 percent) were the major cause of injury.

The program phase which accounted for 87 percent of the injuries was physical education.

Gymnastics Apparatus: accounted for 8.6 percent of the injuries. Injuries to the knee and neck totalled 29.4 percent.

Frequent types of injury were sprains (25.8 percent), fractures (22.6 percent) and contusions (19.4 percent).

Falls on the apparatus caused 77.4 percent of the injuries.

Physical education accounted for 91.2 percent of the injuries.

Gymnastics Tumbling: accounted for 7.3 percent of the injuries. The foot (20.7 percent) and neck (17.2 percent) were frequently injured.

Sprains (44 percent) were the frequent type of injury.

Falls or trips, falls on the apparatus and over-exertion caused 78.9 percent of the injuries.

Physical education accounted for 81.5 percent of the injuries.

Hockey: accounted for 6.6 percent of the injuries. Body regions frequent for injury were the knee (19.2 percent), and the head (15.4 percent). Injuries to the face, head and teeth represented 38.4 percent of the injured regions.

Contusions (26.9 percent) and fractures (26.9 percent) were most frequent.

Blows by an object (37.5 percent) and falls or trips (33.3 percent) caused the majority of injuries.

Approximately 81 percent of the injuries occurred in physical education.

Ice Sports: accounted for 3.5 percent of the injuries.

The head and lower leg represented 35.2 percent.

Contusions (38.5 percent) were the most frequent type of injury.

Falls or trips caused 75 percent of the injuries.

Physical education accounted for 92.9 percent of the injuries.

Racquet Sports: accounted for 3.3 percent of the injuries. The face and head (61.6 percent) were most frequently injured.

Lacerations accounted for 50 percent of the types

of injury.

Blows by an object (50 percent) were frequent, and 61.5 percent of the injuries occurred in physical education.

Soccer: accounted for 3.3 percent of the injuries. Injuries to the knee and foot accounted for 53.9 percent of the injuries to the various body regions.

Sprains (33.3 percent) and fractures (25 percent) were most frequent.

Accidental collisions caused 45.5 percent of the injuries.

Half of the injuries occurred in physical education, and one-third occurred in interscholastics.

Softball: accounted for 1.3 percent of the injuries.

Injuries to the knee and ankle (40 percent) and shoulder and hand (40 percent) were common.

Dislocations accounted for 40 percent of the types of injuries.

Blows by an object and falls or trips caused 66 percent of the injuries.

All injuries occurred in physical education.

Track and Field: accounted for 1.8 percent of the injuries. The back accounted for 28.6 percent of the injuries.

Sprains (28.6 percent) and concussions (28.6 percent) were most frequent.

All injuries resulted from blows by an object and trips or falls.

Physical education accounted for 71.4 percent of the injuries.

Volleyball: accounted for 6.3 percent of the injuries.

The ankle accounted for 36 percent of the injuries, and the finger ranked second for injury, accounting for 20 percent of the injuries.

Sprains occurred most often at 39.1 percent.

One-half of the injuries were the result of falls or trips.

Physical education accounted for 60 percent and interscholastics for 32 percent of the injuries.

Wrestling: accounted for approximately 3 percent of the injuries. Injuries to the elbow/forearm accounted for 18.2 percent of the injured body regions.

Strains (27.3 percent) and fractures (27.3 percent) were common.

Normal body contact caused 63.6 percent of the injuries.

Physical education accounted for 72.7 percent of the injuries.

Miscellaneous Indoor Activities: accounted for 14.9

percent of the injuries. The finger (23.7 percent) was the most frequently injured body region; the wrist (20.4 percent) and head (20.4 percent) ranked second.

Lacerations accounted for 46.9 percent of the types of injury.

Carelessness caused 37.5 percent of the injuries.

Physical education accounted for 42.9 percent and the classroom accounted for 39.3 percent of the injuries.

Miscellaneous Outdoor Activities: accounted for 10.6 percent. Injuries to the head, face and teeth represented 40.4 percent of the injured body regions.

Contusions (20.5 percent), lacerations (15.4 percent) and fractures (15.4 percent) were common.

Normal body contact caused 34.4 percent of the injuries.

Physical education accounted for 53.7 percent of the injuries.

Skiing: accounted for 1 percent of all injuries. Injuries were evenly distributed to the ankle, finger, nose and face.

All injuries were fractures caused by falls or trips.

Physical education accounted for 75 percent of

the injuries.

Program Phase

Physical Education: accounted for 49.2 percent of the injuries. Injuries resulting from falls on the gymnastics apparatus accounted for 12 percent of the injuries. Basketball accounted for 9.3 percent of the injuries, and these injuries usually resulted from a blow by an object. Miscellaneous indoor activities accounted for 9.3 percent of the injuries, and these usually resulted from accidental collisions and blows by an object. Injuries resulting from blows by an object and falls or trips were comparable in incidence, and each accounted for approximately 22 percent of the injuries. Of all injuries in physical education, 8.1 percent resulted from falls on the apparatus during gymnastics, and 4.2 percent resulted from accidental collisions in touch football.

The frequent types of injury were fractures (21.1 percent) and sprains (20.2 percent).

Intramurals: accounted for 3.2 percent of the injuries. Basketball accounted for 23.5 percent of the injuries, the majority of which resulted from accidental collisions. Hockey accounted for 17.6

percent of the injuries, and these usually resulted from blows by an object. Racquet sports accounted for 17.6 percent of the injuries, and these injuries usually resulted from falls or trips, accidental collisions and carelessness. The major cause of intramural injuries was a blow by an object at 17.6 percent.

Of all intramural injuries, 11.8 percent were due to strains in miscellaneous outdoor activities. Fractures (20 percent) were the common type of injury observed.

Interscholastics: accounted for 14.1 percent of the injuries. Tackle football accounted for 33.8 percent of the injuries, and these injuries usually resulted from normal body contact.

The major cause of injury was normal body contact at 40.5 percent.

Of all interscholastics injuries, 21.6 percent were the result of normal body contact in tackle football.

Frequent types of injury were sprains (24.2 percent) and fractures (21.4 percent).

Recess: accounted for 2.9 percent of the injuries. Miscellaneous indoor and outdoor activities accounted for 46.7 percent, and no predominant cause of injury was noted for these activities during recess.

The most frequent cause of injury was a blow by an object at 40 percent.

Of all recess injuries, 13.3 percent were the result of a blow by an object during miscellaneous outdoor activities.

Lacerations (38.5 percent) were the most common type of injury.

Before/After School: accounted for 6 percent of the injuries. Miscellaneous outdoor activities accounted for 18.8 percent, and these injuries usually resulted from blows by an object, carelessness and accidental collisions. Basketball accounted for 12.5 percent of the injuries, and these usually resulted from falls or trips.

Carelessness caused 21.9 percent of the injuries.

Of all injuries, 6.3 percent were the result of falls or trips in basketball.

Lacerations accounted for 28.6 percent of the types of injury.

Classroom: accounted for 24.5 percent. Miscellaneous indoor activities accounted for 17.1 percent of the classroom injuries, and these injuries usually resulted from carelessness.

Carelessness caused 45.7 percent of the injuries in the classroom.

Lacerations (58 percent) were the most frequent

type of injury in the classroom.

Discussion

Reference shall be made to ages and grade levels. The scale referred to is as follows:

Grade	Age
Kindergarten	5
one	6
two	7
three	8
four	9
five	10
six	11
seven	12
eight	13
nine	14
ten	15
eleven	16
twelve	17

Elementary Level

The injury rate for grades kindergarten to six increases concomitantly with increasing age levels and grade levels. Up to and inclusive of grade three (ages 5 to 8), free play which is characterized by lack of structure and random patterns of movement, is most hazardous. For grade four students (age nine) organized activity is most

hazardous. For the students in grades five and six (ages 10 to 11) games and gymnastics are most hazardous.

Males are more frequently injured than females and accounted for 23.8 percent more injuries than females. The rate of injury in games for males was approximately the same as the rate of injury in games for females. This suggests that as the conditions underlying participation are equal (opportunity, types of activities, and levels of participation), the potential for injury does not differ. It is hypothesized that in activities other than games, males are possibly more aggressive and random in their behavior patterns for unstructured activities, which may indicate that they require more control and better supervision.

The playing field (53.4 percent) is the most hazardous facility area, and the gymnasium (20.9 percent) is the facility area second most frequent for injury (16, 76,77,78). The highest incidence rate for injury occurring on the playing fields was 75 percent, as reported by Dale et al. (16) in 1969, in the United States. In Canada, Mendryk et al. (76) in 1977 found the incidence of injury on the playing fields to be 53 percent. It is interesting to note the similarity in results of the study by Mendryk et al. who studied a 10 percent random sample of all provincial schools in Alberta, and the present study which involved all public schools in the city of Edmonton, Alberta.

In the present study, over one-half of all reported injuries occurring on the playing field were caused by accidental collisions and normal body contact, and were accounted for most frequently by students of grades 5 to 7 (ages 10 to 12). Further investigation for an evaluation as to the numbers of supervisors, the quality of the supervision, the existing level of organization and control, and the quality of the playing field must still be forthcoming.

The playing field is the facility area with the highest number of injuries. This observation may be expected when the program phase (recess) frequent for injury and the nature of the activity (free play) frequent for injury are noted. The opportunity for participation, numbers involved in a restricted area, and inadequate supervision must be considered.

The highest number of injuries occurred during recess. Lunchtime ranked second for rate of injury in a program phase. Similar results were reported by Mendryk et al. (76), Dale et al. (16), and Mendryk and King (78). The high percentage of injuries occurring at recess indicated that a further evaluation of the possible causes of injury should be forthcoming. During recess, usually the numbers of individuals participating in a confined area are large, the opportunity and time for participation are great, the nature of the activities for ages varies, and the number of supervisors in relation to the

number of students participating is low. The majority of injuries which occurred at recess were minor in severity (head and facial lacerations), were frequently caused by falls or trips, and could be effectively managed or treated by the supervisor on duty. The quality of supervision, an increase in the number of supervisors, an introduction of control, and an evaluation of the playing surface area are suggested.

Generally, the types of injury are minor in severity. Lacerations and contusions to the head and face, and dental attrition were observed to be most frequent (76,77,78). At this level of interaction, body momentum, velocity and impact forces are minimal due to the small physical size and body mass. Additionally, body contact is not an intrinsic aspect of the majority of injuries occurring at the elementary level.

Falls or trips are the most frequent cause of injury, and accidental collisions are the secondary cause of injury. Mendryk et al. (76) support these findings.

Causes of injury are directly related to the nature of the activity, the skill level, and the program phases offered. As the grade level increased, probable direct causes of injury changed from self-imposed causes to causes involving an external object or person. Falls or trips were the most frequent cause of injury for individuals of eight years of age (grade four) or less, whereas accidental collisions were most frequent for

ages 8 to 11 years.

The activity (free play) highest for rate of injury complements the program phase (recess), facility areas (playing field) and times of day frequent for injury. Free play was the most hazardous activity, and causes of injury were frequently falls or trips (76,78). Overall, grade six was the individual grade noted to have the highest incidence of injury in free play. Mendryk et al. (76) supported this result. A more indepth investigation demonstrated that grade six males accounted for 10.9 percent of all free play injuries. It is hypothesized that the grade six level, and males in particular, require some form of organized activity at recess. Better control through supervision and organization of recess and free play is suggested.

In gymnastics, the majority of injuries were accounted for by students in grades five and six. In gymnastics, performers and spotters require high levels of strength to perform. It is hypothesized that at the level of grade five and six, the requirements for safe participation in gymnastics are underdeveloped for the minimum basis required for safe participation. A re-evaluation of the activity, and quality of supervision and instruction is suggested by the results found.

Secondary Level

The injury rate was observed to increase up to

grade nine, after which a decrease was noted (66,76,77, 78). The decrease in injury from grades 10 to 12 may be explained by the fact that physical education is not compulsory in grades eleven and twelve. The trend towards an increase in injuries from elementary to junior high school is related to the greater number of participation hours, a broader spectrum of activities, varied levels of competition, and an increase in body contact.

Up to and inclusive of grade nine, results indicate an increase in female participation. This may be a result of the same numbers of females injured more often, or more females participating and becoming injured. Both suggestions appear plausible, but there was no data to support either suggestion. At the elementary level the difference in the injury rate for the sexes was 23.8 percent, males being the most frequently injured. Males accounted for only 5.8 percent more injuries than females in grades 7 to 9. For grades 10 to 12 the difference in the rate of injury for the sexes increased to 29.8 percent, males being the sex with the higher injury rate. Activities and program phases available are similar for both males and females in grades 7 to 9 and this may explain the closely approximated injury rate in junior high school. Physical education is no longer compulsory for grades eleven and twelve, yet an increased rate of injury for males in grades 10 to 12 occurred. It is hypothesized that the increase may be

the result of a greater emphasis placed on interscholastic sports, which are generally directed towards males more frequently, and involve body contact.

Physical education is the program phase with the highest injury rate (66,76,77,78). The high rate of injury for this program phase is not unexpected when one considers that physical education offers the greatest opportunity for participation, tends to involve large numbers, offers a wide range of activities, is offered to both sexes and has a substantial amount of time devoted to it.

Falls off the gymnastics apparatus caused the majority of injuries in physical education. For grades 7 to 9, 6.4 percent of the injuries occurring during physical education resulted from falls off the gymnastics apparatus. It was recorded that grade nine was the individual grade which accounted for the highest rate of injury on the gymnastics apparatus. Results indicate that this activity is hazardous for the age level 12 to 14 years. For grades 10 to 12, the rate of injury on the gymnastics apparatus increased to 8.1 percent. It is hypothesized that the high rate of injury on gymnastics apparatus may be the result of inadequate supervision, spotting and instruction. Until a further investigation concerning gymnastics apparatus is performed, it is suggested that more emphasis be placed on other activities that demonstrate a lower injury rate.

The type of injury frequently occurring in physical education for the grade categories, increases in severity from grades 7 to 9, to grades 10 to 12. Contusions and sprains were the most frequent types of injury to students in grades 7 to 9, while fractures and sprains were the most frequent injury for students in grades 10 to 12. Similar results were reported by Mendryk et al. (76).

Rates of injury in physical education, the program phase most frequent for injury, did not change appreciably as grade categories changed. Intramurals are twice as injurious to students in junior high school as to students in senior high school. Interscholastics are three times more injurious to students in grades 10 to 12 than to students in grades 7 to 9. It is hypothesized that participation and emphasis are greater on intramurals for grades 7 to 9, and on interscholastics for the grade 10 to 12 level. Intramural activities are characterized primarily by non-contact sports (volleyball, basketball) and interscholastics are usually characterized by contact sports (tackle football). These observations lend further support as to possible reasons underlying the emphasis of intramurals in grades 7 to 9 as opposed to interscholastics, especially if consideration is made as to the nature of body contact in the activity and the level of physical development of the participant.

The most probable cause of injury in an activity was observed to be a normal characteristic of the activity. For example, normal body contact was the common cause of injury in tackle football. The major cause of injury in basketball was a blow from an object, the object being the basketball in the majority of the injuries. Direct modification of the causes of injury, without changing the nature of the sport, is unlikely, but further analysis of indirect causes such as rules, officiating, and technique is suggested.

The severity of injury is observed to increase when a comparison is made of the types of injury frequently observed in intramurals and the types of injury frequently observed in interscholastics. Contusions and fractures were the most common types of injury occurring in intramurals (characterized by low-level structure). Sprains and fractures were the most common injuries observed in interscholastics (characterized by high-level structure and organization).

Injuries occurring during physical education for grades 7 to 9 were highest from 9:00-10:59 a.m. (29.1 percent) and again from 2:00-2:59 p.m. (17.9 percent). For grades 10 to 12, 9:00-10:59 a.m. accounted for 27.5 percent of the injuries occurring in physical education and 2:00-2:59 p.m. accounted for 17.2 percent. Mendryk and King (78) observed no peak time of day existed for injury during physical education, but that an even

distribution occurred.

Hazardous times of day at the secondary school level were also noted to be 12:00-12:59 p.m. and after 4:00 p.m. Further investigation showed that these times correlated with intramurals and interscholastic activity respectively (76).

The pattern of injury to body regions changes, and the types of injury increase in severity as grade level increases. Lacerations to the finger, head, and ankle were most frequent to students in grades 7 to 9. Mendryk and Dickau (77), and Mendryk and King (78) noted similar results. Injuries most frequent to grades 10 to 12 were lacerations and sprains occurring to the finger, ankle and head (77). Mendryk et al. (76) observed that the body regions most frequently injured in grades 7 to 12 were the ankle and knee, wrist and finger, and head and face. Body regions frequently injured did not change appreciably from the study done by Mendryk and King (78) in 1969 to the study completed by Mendryk et al. (76) in 1976. Thus, some sports may predispose certain areas of the body to injury.

As the nature of the program phase changes to include more contact sports, the severity of injury increases. Sprains and contusions were the most common injuries observed during physical education. Contusions and fractures were the most common injuries noted in intramurals and sprains and fractures were the most

common injuries observed in interscholastics.

The incidence of injury to females was observed to peak approximately one year earlier than males (78). At the secondary school level, the peak age for injury to females was fourteen years of age. Glasgow (31) in 1976 reported similar results. Differences in growth and the earlier onset of puberty for females may explain the difference.

Overall, basketball is the structured activity with the highest rate of injury (11.2 percent). The activity is offered in all program phases, and is offered on an equal basis to males and females. It should be noted that the injuries in basketball are minor in nature. Sprains of the ankle and finger were frequent (76) and resulted from a blow by an object and accidental collisions (76,115,116).

Tackle football is offered in the program phase of interscholastics, thus explaining the high rate of injury to the student of 15 to 17 years of age (19,33,76). The present study demonstrated that the knee was the most frequently injured body region for the 15 to 17 year old, (23.1 percent). Although not involving a school population, but for the same age category, results of Yost (116) in 1972 and Dufresne (19) in 1971 supported the present findings. Mendryk et al. (76) reported the most frequently injured body regions for the 15 to 17 year old were the ankle and foot (19 percent). Normal body

contact is the most frequent cause of injury (19,45,76, 93). Thus the probable direct cause most prevalent for injury is an integral aspect of the activity and cannot be eliminated without radically changing the nature of the activity.

The rate of injury for gymnastics did not change significantly from junior to senior high school, but may be considered to be high in each grade category. Injuries were noted to be more severe for the 15 to 17 year old athlete. On the gymnastics apparatus, contusions and sprains of the ankle were frequent injuries to students in grades 7 to 9. Sprains and fractures, frequently to the neck and knee regions, were the most common injuries for students in grades 10 to 12. For tumbling in grades 7 to 9, strains of the neck and back regions were the most common injuries. For tumbling in grades 10 to 12, sprains to all body regions were frequent. Similar results were reported by Mendryk et al. (76). Falls from the apparatus were the most frequent cause of injury overall, and the highest program phase for injury in gymnastics was physical education (76). Gymnastics is a hazardous activity for the female in junior high school since approximately 17 percent of the injuries on the gymnastics apparatus occurred to fourteen year old females, and 20 percent of the tumbling injuries occurred to fourteen year old females. Further evaluation and a more indepth analysis as to the causes of

injury is necessary, if a reduction of the incidence and severity of injury are to occur.

In the activity of ice hockey, fifteen years of age was the peak age for injury. This result is supported by Reeves and Mendryk (87). As body size increases with age, the severity of injury increases as a result of greater impact forces, mass and velocity. Lacerations and contusions frequently to the head, were the most common injuries to students of grades 7 to 9 (40,87). The most frequent injuries to students of grades 10 to 12 were contusions, fractures and sprains, common to the head and knee regions (13,46,55,87,105). Blows from an object were observed to be the most frequent and inherent cause of injury (40,49,76,84,88,113,115,116).

Grade seven students in physical education accounted for 25.4 percent of all injuries reported in the activity of soccer. Soccer is possible the activity offered most frequently at this grade level.

Thirty-seven percent of all volleyball injuries occurred to students in grades eight and nine, during physical education. Finger sprains were the most frequent injury at the junior high school level and ankle sprains were the most frequent injury at the senior high school level. The present results are similar to those found by Mendryk et al. (76).

Skiing is not offered in the school system as frequently or as regularly as other activities. In contrast

to the other activities, ski injuries were few in number, but found to be severe when they occurred. Injuries consisted primarily of lower limb fractures (23,89,117) caused by trips or falls (89,111,112,117). The thirteen and fourteen year old student was most frequently injured (10,24,89).

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The purpose of the study was to determine the incidence, nature and cause of sports injuries occurring in organized and unorganized activity to the school-age participant.

The sample consisted of 3,653 reported injuries received by students who were registered in the Edmonton Public School system over the two-year academic term of 1974-1975 and 1975-1976.

The injury report form (Appendix A) used for the data collection was placed in all of the public schools in Edmonton, Alberta. Instructions regarding the correct procedure for the completion of the forms and a definition of terms were provided along with the forms. Completion of the forms was done by the physical educator, coach or teacher on duty at the time of injury. Three copies of the report form were sent to the Edmonton Public School Board and one copy of the form was retained by the school where the injury occurred. The forms were then collected after arrangements were made between the author and the Edmonton Public School Board. An S.P.S.S. computer program was designed to yield incidence totals and possible causal relationships. Selected three-way cross-tabulations of individual and grouped grades were

computer run and analysed. Interpretations and recommendations followed.

The overall rate of injury for the two-year period was 25.7 per thousand, and males represented the sex with the highest injury rate overall (59.3 percent). Grades kindergarten to 6 accounted for the majority of all reported injuries (47.8 percent).

Generally, the highest number of blows by an object and falls on gymnastics apparatus occurred in the gymnasium. The majority of falls or trips, obstructions, accidental collisions and normal body contact injuries occurred on the playing field. Injuries caused by carelessness occurred most frequently in the classroom.

Grades Kindergarten to 6

The majority of injuries occurred to males. The facility area highest for injury was the playing field, and causes of injury were frequently accidental collisions and normal body contact. Peak times of day for injury corresponded to afternoon recess, morning recess and lunchtime, in descending order.

The body region frequently injured was the head. Head injuries were frequent during recess, and the commonest head injury was a laceration. Lacerations and contusions were the most common types of injury. This was observed for the individual sexes, as well as overall.

The frequent probable direct cause of injury was a fall or trip, and the majority of falls or trips occurred on the playing field.

Free play was the activity accounting for the most injuries, and the major cause of injury was a fall or a trip. In organized activity the major cause of injury was a fall or trip. In games, blows by an object were the frequent cause of injury. In gymnastics, falls from the apparatus were the major cause of injury. With the exception of games and dance where females were injured more frequently, males accounted for the majority of injuries in all other activities.

Recess was the program phase with the highest number of injuries. The head was the most frequently injured body region, and a laceration was the most common type of injury. Falls or trips and accidental collisions were the most frequent causes of injury.

Lacerations to the head were the most frequent injuries occurring before/after school. Falls or trips were the common cause of injury.

During physical education, the head was frequently injured. Contusions were the common type of injury, and falls or trips were the major cause of injury.

In the classroom, the face was frequently injured and lacerations caused by carelessness were the most common.

Intramural and interscholastic injuries were few

in numbers but occurred most commonly to the head and consisted frequently of a contusion or laceration caused from a blow by an object.

Grades 7 to 9

The majority of injuries occurred to males. Physical education was the program phase highest for injury, and gymnastics apparatus was the hazardous activity in physical education. The gymnasium was the facility with the highest injury rate.

The peak time of day for injury was 2:00-2:59 p.m. Injuries in physical education peaked during 9:00-10:59 a.m. Intramural injuries were frequent between 12:00-12:59 p.m. Injuries in the classroom were common from 1:00-2:59 p.m. All scholastics injuries occurred after 4:00 p.m.

The finger was the most frequently injured body region. The upper limb was injured at a higher rate than the lower limb.

Lacerations were the frequent type of injury overall and for males. Contusions were the frequent type of injury for females.

The major cause of injury to grade seven students was carelessness. Blows by an object were the most frequent cause of injury to students in grades eight and nine. The majority of normal body contact injuries occurred in the gymnasium, whereas the highest incidence

of accidental collisions were reported during activities on the playing fields.

Miscellaneous indoor activities ranked first for the highest number of injuries. Basketball was the structured activity with the greatest number of injuries.

A summary of the activities accounting for approximately 75 percent of the injuries will follow in descending order of incidence.

Miscellaneous Indoor Activities: Injuries were frequent to the head. Lacerations were common. Carelessness was the frequent cause of injury. Physical education was the program phase highest for injury.

Basketball: Injuries were frequent to the finger. Sprains were common. Blows by an object were the frequent cause of injury. Physical education was the program phase highest for injury.

Gymnastics Apparatus: Injuries were frequent to the ankle. Contusions were common. Falls on the apparatus were the frequent cause of injury. Physical education was the program phase highest for injury.

Track and Field: Injuries were frequent to the ankle. Sprains were common. Falls from the apparatus were the common cause of injury. Physical education was the program phase highest for injury.

Miscellaneous Outdoor Activities: Injuries were frequent

to the foot, elbow/forearm, and finger. Lacerations were common. Falls or trips were the frequent cause of injury. The majority of injuries occurred before/after school.

Volleyball: Injuries were frequent to the finger. Sprains were common. Blows by an object were the major cause of injury. Physical education was the program phase highest for injury.

Gymnastics Tumbling: Injuries were frequent to the neck and back. Strains were common. Over-exertion was the major cause of injury. Physical education was the program phase noted to have the highest injury rate. The majority of injuries occurred from interaction on the gymnastics apparatus.

Miscellaneous indoor activities was the activity with the highest rate of injury during intramurals and blows by an object were the most frequent cause of injury.

For interscholastics, basketball was the activity which accounted for the highest injury rate and the commonest cause of injury was a blow by an object.

At recess, injuries were well distributed among the activities. The most probable causes of injury were falls or trips, blows by an object, and normal body contact.

For the program phases of before/after school and in the classroom, miscellaneous indoor activities accounted

for the majority of injuries, and carelessness was the most frequent cause of injury.

Grades 10 to 12

The majority of injuries occurred to males. Physical education was the program phase highest for injury, and the majority of injuries occurred on the gymnastics apparatus. The gymnasium was the facility area noted to have the highest rate for injury.

The peak time of day for injury to grades ten and eleven students was 2:00-2:59 p.m. Injuries which occurred to students in grade twelve were well-distributed throughout the day. For grades ten and eleven, injuries in physical education peaked for incidence from 8:00-9:59 a.m., and 2:00-2:59 p.m. All interscholastic injuries occurred after 4:00 p.m., whereas intramural injuries were most frequent from 12:00-12:59 p.m. A dangerous time of day for classroom accidents was 9:00-10:59 a.m.

Overall, for all activities in all of the various program phases, the finger was the body region most frequently injured.

Generally, lacerations were the most frequent type of injury. Lacerations were the most common injury to males, whereas sprains were the most common injury to females.

Blows from an object were the frequent cause of

injury to grades ten and eleven students, and carelessness was the frequent cause of injury to grade twelve students. The majority of normal body contact injuries occurred on the playing field and the highest incidence of accidental collisions occurred in the gymnasium.

Miscellaneous indoor activities account for the activity with the highest rate for injury. The activity observed to have the highest injury rate for all structured activities was basketball.

A summary of the activities accounting for approximately 75 percent of the injuries will follow, in descending order of incidence.

Miscellaneous Indoor Activities: Injuries were common to the finger. Lacerations were common. Carelessness was the frequent cause of injury. Physical education was the program phase highest for injury.

Miscellaneous Outdoor Activities: Injuries were common to the face, head and teeth. Contusions were common. Normal body contact was the frequent cause of injury. Physical education was the program phase highest for injury.

Basketball: Injuries were common to the ankle. Sprains were frequent. Falls or trips were frequent. The majority of injuries occurred in physical education.

Gymnastics Apparatus: Injuries were common to the knee

and neck. Sprains were common. Falls from the apparatus were the major cause of injury. The majority of injuries occurred in physical education.

Gymnastics Tumbling: Injuries were frequent to the foot. Sprains were common. Falls or trips, overexertion, and falls from the apparatus were major causes of injury. Physical education was the program phase highest for injury.

Hockey: Injuries were frequent to the face, teeth and head. Contusions and fractures were common. Blows by an object were the major cause of injury. The majority of injuries occurred in physical education.

Volleyball: Injuries were frequent to the ankle. Sprains were common. Falls or trips were the major cause of injury. Physical education was the program phase with the highest injury rate.

Touch Football: Injuries were frequent to the head. Contusions were common. Accidental collisions were a major cause of injury. Physical education was the program phase highest for injury.

Physical education was the most injurious program phase, and the gymnastics apparatus was the activity most frequent for injury. In physical education, blows by an object were the most common cause of injury.

For intramurals, basketball was the most hazardous

activity, and blows by an object caused the majority of injuries.

For interscholastics, tackle football accounted for the majority of injuries. Normal body contact was the most frequent cause of injury.

At recess, miscellaneous indoor and outdoor activities accounted for the majority of injuries, and blows by an object were the frequent cause for injury.

For the program phase of before/after school, miscellaneous outdoor activities accounted for the majority of injuries. Blows by an object, carelessness and accidental collisions were the most common causes of injury.

In the classroom, miscellaneous indoor activities were the most hazardous and carelessness was the most common cause of injury.

Conclusions

Within the scope of the study, certain conclusions were drawn.

1. Overall, males are more prone to injury.
2. Differences in growth and maturation patterns affect the peak ages for injury to males and females. This is based on the fact that females in elementary school reached a high point for injury in grade four (nine years of age) and males reached a high point for injury in grade six (eleven years of age). At

the secondary level of education, females reached a high point for injury in grade nine (fourteen years of age) and males reached a high point for injury in grade ten (fifteen years of age).

3. Children are generally most prone to injury at approximately 14 to 15 years of age.
4. Generally, the program phase, the type of injury and the probable direct cause of injury complement the sport, the rules and regulations for play, and the facility area required for play. For example, in volleyball the majority of injuries occurred during physical education classes conducted in the gymnasium. The frequent injury was a sprain of the finger or ankle caused by being hit with an object (the volleyball) or falling (landing on another individual's foot or from a jump) and was not the result of colliding with support stands or other unusual manner of injury. No unusual trends for injury occurred, but were as could be expected.
5. When the program phases were compared, the injury rate increased in severity from physical education to intramurals to interscholastics. Reflected is the increase in severity of injury with increasing age and change in physical size, the variations in the structure and organization of activities, the skill level and the degree of involvement.
6. Contact sports, especially in interscholastics are

more hazardous at the senior high school level, and non-contact sports, especially in intramurals, are more hazardous at the junior high school level.

7. A shift in emphasis occurred from elementary to secondary school of injuries occurring in random, unstructured patterns of movement to activities characterized by structure and organization. Reflected is the introduction of new activities, the demand for increased skill development, the introduction of varied levels of competition, and the addition of regulations.
8. Basketball and the gymnastics apparatus are the most hazardous activities at the secondary school level, whereas free play is the most hazardous activity at the elementary school level.

Recommendations

The following recommendations are made to help reduce the number of injuries to the young athlete, at the present time and in the future.

1. A thorough re-evaluation of all facets of physical education (activities with high injury rates, the facility areas, the quantity of instruction, class size, and equipment) in the secondary schools is needed. This is based on the results that physical education classes accounted for the majority of injuries at the secondary school level.

2. Better supervision, officiating, and first-aid care should be provided during intramural activity since the injuries are numerous but minor in nature.
3. A manual and yearly clinics concerning the prevention, early recognition and initial management of injuries commonly occurring in sports should be developed for the physical educator or coach.
4. All teachers should be required to complete a first-aid/athletic injuries recognition and management course. The placement of stocked first-aid kits for use in all gymnasiums and at recess should be required. This recommendation is based on the fact that the majority of injuries occur at recess and during physical education, are minor in severity, and could be competently managed by the teacher on duty.
5. The feasibility of offering instruction on gymnastics apparatus extramurally through clubs and interscholastics should be investigated. The gymnastics apparatus is a difficult activity demanding high levels of fitness, co-ordination, flexibility and strength in order to perform safely, and to spot participants safely. Within the limitations of a physical education class, these factors cannot be developed adequately. Where equipment is necessary, special precautions are necessary such as small class sizes, and an overabundance of spotters.

Until such time when further evaluation may be possible concerning instructional techniques, quantity and quality of supervision, class sizes and quality of equipment, it is recommended that the emphasis be placed on Swedish gymnastics and movement education.

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Appendix A

Injury Report Form

EDMONTON PUBLIC SCHOOLS

ACCIDENT REPORT FORMS 82-02468

(Make FOUR copies - send THREE to the Secretary-Treasurer's Office. Retain ONE in school.)

School _____ Date _____

Name of Pupil _____

Does pupil have school accident insurance? _____ Type _____
Does pupil have other accident insurance? _____ Type _____
Was a physician or hospital called? _____ Name _____

INDICATE THE ONE (OR MORE) APPROPRIATE STATEMENT(S) FROM EACH OF THE FOLLOWING SECTIONS

A. Sex ( ) 6. Male ( ) 7. Female

B. Age
( ) 8. six or younger ( )13. eleven ( )18. sixteen
( ) 9. seven ( )14. twelve ( )19. seventeen
( )10. eight ( )15. thirteen ( )20. eighteen
( )11. nine ( )16. fourteen ( )21. nineteen
( )12. ten ( )17. fifteen ( )22. twenty plus

C. Grade
( )23. kindergarten ( )28. five ( )33. ten
( )24. one ( )29. six ( )34. eleven
( )25. two ( )30. seven ( )35. twelve
( )26. three ( )31. eight ( )36. special education
( )27. four ( )32. nine ( )(i) other _____

D. Time of day
( )37. before 8:00 a.m. ( )43. 1:00 - 1:59
( )38. 8:00 - 8:59 ( )44. 2:00 - 2:59
( )39. 9:00 - 9:59 ( )45. 3:00 - 3:59
( )40. 10:00 - 10:59 ( )46. 4:00 - 4:59
( )41. 11:00 - 11:59 ( )47. 5:00 - 5:59
( )42. 12:00 - 12:59 p.m. ( )48. after 6:00

E. Body Region(s) Injured
( )49. head ( )57. forearm ( )65. groin
( )50. face ( )58. wrist ( )66. thigh
( )51. nose ( )59. hand ( )67. knee
( )52. teeth ( )60. finger ( )68. lower leg
( )53. neck ( )61. chest ( )69. ankle
( )54. shoulder ( )62. abdomen ( )70. foot
( )55. upper arm ( )63. back
( )56. elbow ( )64. buttocks

F. Type(s) of Injury
( )71. abrasion - scrape
( )72. laceration/incision/puncture - an open wound
( )73. burn
( )74. bone bruise - swelling and/or discoloration of bony area
( )75. muscle bruise - swelling and/or discoloration of muscular area
( )76. muscle strain (pull or tear) - due to use rather than blow
( )77. sprain - twisting or moving of a joint beyond normal range
( )78. dislocation/separation - deformity of a joint
( )79. fracture
( )80. concussion - temporary loss of orinetation or unconsciousness
( ) 6. nose bleed
( ) 7. teeth - loosened or broken
( ) i. other _____

_____

_____

OVER

G. Facility Area where accident occured

( ) 8. gymnasium
( ) 9. playing field or tarmac
( )10. classroom or lab
( )11. on playground climbing or play apparatus
( ) i. other _____
( )12. hallway or stairway
( )13. rink
( )14. in transit to or from school
( )15. locker room or shower room
( )16. pool

H. Probable Direct Cause

( )17. blow delivered by an object (ball, bat, etc.)
( )18. fall or trip not due to any observed external factor
( )19. fall or loss of balance where apparatus concerned
( )20. obstruction on playing area (object or spectator)
( )21. accidental collision between participants
( )22. body contact (not considered a collision) in the normal course of an activity
( )23. strain or overexertion
( )24. carelessness on part of pupil
( )25. no clear or apparent cause
( ) i. other _____

I. Program Phase

( )26. physical education instruction
( )27. intramural or house league
( )28. interscholastic game or practice
( )29. recess
( )30. before or after school, noon hour play
( )31. classroom or lab instruction

SECTION J APPLIES TO DIVISIONS I AND II ONLY. ALL OTHERS COMPLETE SECTION K.

J. Activity (elementary)

( )32. free play - spontaneous activity
( )33. organized activity - recess, noon hour, etc.
( )34. dance lessons
( )35. games lesson
( )36. gymnastics lesson
( ) i. other _____

K. Activity (junior and senior high)

( )37. aquatics
( )38. basketball
( )39. bordenball
( )40. dance
( )41. European handball, field ball, field hockey
( )42. floor hockey
( )43. football (tackle)
( )44. football (flag, touch)
( )45. gymnastics (apparatus)
( )46. gymnastics (free exercise, tumbling)
( )47. ice hockey
( )48. ice sports (other)
( )49. racquet games
( )50. soccer or speedball
( )51. softball or baseball
( )52. track & field or cross country
( )53. volleyball
( )54. wrestling and personal defence
( )55. miscellaneous indoor activities (specify) _____
( )56. miscellaneous outdoor activities (specify) _____

Brief description of accident:

_____

_____

_____

Names: Principal _____

Teacher _____

Witness(es) _____

_____

_____

RZ/jm
Nov./75

Appendix B

Tables for Individual Grades

and

Grades Kindergarten to 6

Table 1

Grade x Time of Day

Grade	Time of Day											
	Before 8:00 a.m.	8:00-8:59 a.m.	9:00-9:59 a.m.	10:00-10:59 a.m.	11:00-11:59 a.m.	12:00-12:59 p.m.	1:00-1:59 p.m.	2:00-2:59 p.m.	3:00-3:59 p.m.	4:00-4:59 p.m.	5:00-5:59 p.m.	After 6:00 p.m.
Kindergarten		5	9	17	5	8	9	13	6			
One	1	8	8	49	18	39	27	48	10			1
Two		12	2	50	15	25	20	57	16	1		
Three		12	7	62	13	25	33	67	16			
Four	1	6	8	57	19	28	24	73	21	2	1	2
Five	2	12	15	63	29	23	20	82	24	1		
Six		8	10	77	27	23	31	106	31	5		2
Seven		21	55	56	52	58	53	74	35	10		4

Table 1 (continued)

Grade	Time of Day											
	Before 8:00 a.m.	8:00-8:59 a.m.	9:00-9:59 a.m.	10:00-10:59 a.m.	11:00-11:59 a.m.	12:00-12:59 p.m.	1:00-1:59 p.m.	2:00-2:59 p.m.	3:00-3:59 p.m.	4:00-4:59 p.m.	5:00-5:59 p.m.	After 6:00 p.m.
Eight		8	46	70	60	40	55	72	32	7	4	
Nine		7	58	80	52	49	61	78	30	16	7	3
Ten	2	18	43	36	27	34	43	56	8	11	8	3
Eleven		10	23	27	15	15	18	28	6	2	13	5
Twelve		3	10	10	15	7	12	9	3	13	4	4

Table 2

Grade x Facility Area

Grade	Facility Area					
	Gymnasium	Playing Field	Classroom	Play Apparatus	Rink	Pool
Kindergarten	7	16	13	10	2	
One	21	68	26	29	7	
Two	20	80	18	28	4	
Three	37	96	16	27	2	
Four	44	100	14	12	3	
Five	50	117	14	18	8	1
Six	66	143	27	12	5	
Seven	135	69	69	9	5	1
Eight	144	58	64	7	7	1
Nine	184	76	62	1	7	1
Ten	110	58	32	7	13	4
Eleven	53	30	21	10	3	1
Twelve	21	21	18		1	

Table 3

Grade x Program Phase

Grade	Program Phase					
	Physical Education	Intramurals	Inter-Scholastics	Recess	Before/After School	Classroom
Kindergarten	13			16	21	14
One	25	1	2	75	76	20
Two	26	2	1	95	53	9
Three	45		3	105	58	13
Four	55	8	4	99	51	17
Five	75	7		106	49	21
Six	84	17	7	124	56	26
Seven	176	26	11	7	87	87
Eight	202	16	12	4	41	93
Nine	234	22	33	7	41	86
Ten	171	7	28	10	19	49
Eleven	74	3	23	3	7	45
Twelve	14	7	24	2	7	34

Table 4

Grade x Probable Direct Cause

Grade	Probable Direct Cause							
	Blow by Object	Fall or Trip	Fall on Apparatus	Obstruction	Collision with Person	Normal Body Contact	Over-Exertion	Careless-ness
Kindergarten	9	31	10		4	4		6
One	24	47	27	9	33	14		24
Two	24	50	24	4	40	10	2	20
Three	30	58	26	9	51	11	1	25
Four	40	45	21	8	44	18	2	19
Five	46	68	26	13	43	13		25
Six	64	69	28	3	65	18	3	32
Seven	69	67	31	11	57	27	11	85
Eight	74	45	36	5	50	24	16	73
Nine	91	69	44	13	40	28	23	62
Ten	52	47	28	3	36	25	15	39
Eleven	29	24	9	2	15	23	7	24
Twelve	12	12	1		12	14	2	17

Table 5
Sex x Type of Injury
for Grades K-6

Sex	Type of Injury	Teeth - Loose/Broken	Nosebleed	Abrasion	Laceration	Contusion	Strain	Sprain	Dislocation	Fracture	Concussion	2+ Injuries
	Male	123	19	63	325	150	20	50	8	117	49	42
	Female	53	9	41	122	146	28	55	7	67	32	33

Table 6
Grade x Activity
for Individual Grades K-6

Grade	Activity				
	Free Play	Organized Activity	Dance	Games	Gymnastics
Kindergarten	33	6	1	3	3
One	99	30	1	7	10
Two	83	50	1	15	8
Three	105	36	1	24	11
Four	96	56	1	26	12
Five	96	40	1	38	21
Six	117	53	3	45	21

Table 7
Program Phase x Body Region
for Grades K-6

Program Phase	Body Region																			
	Head	Face	Nose	Teeth	Neck	Shoulder	Upper Arm	Elbow/ Forearm	Wrist	Hand	Finger	Chest/ Abdomen	Back	Buttocks/ Groin	Thigh	Knee	Lower Leg	Ankle	Foot	2+ Regions
Physical Education	79	46	11	30	4	9	3	21	19	9	27	9	20	1	5	19	8	21	12	13
Intramurals	3	9	2	7	1	1	1	2	2		2		1		1	1			2	3
Inter-Scholastics	1	4	3	3		1		2		1	1				2	2	1	1		2
Recess	167	89	17	92	6	19	7	37	28	19	29	5	13	6	6	36	9	17	10	16
Before/ After School	116	61	9	43	2	13	4	9	15	15	25	1	6	2	4	23	8	11	10	10
Classroom	33	39	4	13		1	2	5	4	6	30		4		1	5	3	3	7	6

Table 8
Program Phase x Type of Injury
for Grades K-6

Program Phase	Type of Injury										
	Teeth-Loose/Broken	Nosebleed	Abrasion	Laceration	Contusion	Strain	Sprain	Dislocation	Fracture	Concussion	2+ Injuries
Physical Education	27	8	16	61	70	23	41	2	42	18	16
Intramurals	6		2	5	9	2	4		3	2	
Interscholastics	3	2	3	4	4	1			4	1	2
Recess	81	8	34	142	105	16	38	5	81	28	23
Before/After School	38	8	23	122	58	1	16	7	40	24	23
Classroom	11		15	76	25	3	2	1	7	4	4

Table 9
Program Phase x Probable Direct
Cause for Grades K-6

Program Phase	Probable Direct Cause							
	Blow by Object	Fall or Trip	Fall on Apparatus	Obstruction	Accidental Collision	Normal Body Contact	Over-Exertion	Carelessness
Physical Education	80	92	57	3	59	15	4	22
Intramurals	14	6	5	2	4	3		1
Interscholastics	7	2	2	1	6	2	1	
Recess	84	152	45	20	150	48	1	59
Before/After School	44	98	44	14	61	23	2	53
Classroom	24	35	5	4	11	3		46

Table 10
Activity x Probable Direct Cause
for Grades K-6

Activity	Probable Direct Cause							
	Blow by Object	Fall or Trip	Fall on Apparatus	Obstruction	Accidental Collision	Normal Body Contact	Over-Exertion	Carelessness
Free Play	82	160	74	28	149	40	2	52
Organized Activity	51	64	22	6	53	24	1	25
Dance		2	3		2	2		
Games	55	42	8	1	34	5	1	9
Gymnastics	8	12	38	1	6	3	1	6

Appendix C

Tables for Grades 7-9

Table 11
Activity x Program Phase
for Grades 7-9

Program Phase	Activity																					
	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
Physical Education	2	65	7	5	10	1	17	71	48	9	16	6	42	13	62	48	26	69	24	17
Intramurals		6					7	6	3	1		1	4		5	5	6	11	4	
Inter-Scholastics		22				1		1	1			1	1	1	10	6	6			
Recess			1			1		1	1					1				1	1	
Before/ After School	2	2				2	2	3	4			2	2	1	6	3		36	31	1
Classroom	1		1			1	2	1					1					39	10	1

Table 12
Activity x Body Region
for Grades 7-9

Body Region	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
Head		5	1		2	1	2	5		4	6	2	2	1	9	5	3	29	11	1
Face		7	2		1		1	2		3	4	3	3	3		7	2	19	8	2
Nose		4					1	1			1		2	4		1		10	1	
Teeth		4					1	2	2	1		1	1	1	3	1	1	13	5	1
Neck								6	13						3		3	2		1
Shoulder		2			1		1	2	2						2		10		4	1
Upper Arm				1				1							1			2		1
Elbow/Forearm		1				1	2	5	1		1		3		5	3	4	14	8	
Wrist		3			1	1		9	6		2		4	1	3	6	2	8	1	2
Hand		1	1		1		4	5	1						2	1		12	5	
Finger	2	34	1		1		6	4	2		2	1	1		4	15	2	25	8	4

Table 12 (continued)

Body Region	Activity																						
	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
Chest/ Abdomen		1				1		2	2				1	1		1		1	2	
Back		3					2	8	11	1			2		14	2	4	3	2	1
Buttocks/ Groin		1						1					1		2					
Thigh	1							1	1				1		2	2		1	4	
Knee		3	1	1	1	1	6	5	2			1	4	1	2	2	5	6	6	4
Lower Leg	2						1						5	3	2			3	2	4
Ankle		23		2		1	2	10	5	1			10	2	15	10	4	9	7	1
Foot		3		1	1		1	9	5				7		8	2		3	1	
2+ Regions		1	3					4	3			1	1		5	3		4	2	

Table 13
Activity x Type of Injury
for Grades 7-9

Type of Injury	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
	Activity																			
Teeth-Loose/Broken		2	1				1	2	2	1		1	2	1	3		1	12	3	1
Nosebleed		3												1		1		2	1	
Abrasion		1					2			1	1			1	2	3		6	4	1
Laceration	3	2			1		6	7		2	4	1	2		8	1	2	50	22	3
Contusion	1	19	3		6	2	5	17	6	2	2	3	15	4	15	7	7	23	9	1
Strain		6					2	13	19	1			1	1	13	7	7	8	5	2
Sprain		30		3		1	8	16	5		1		15	3	19	19	8	10	8	4
Dislocation		4	1	1	1				3	1	1	1		1	2	2	3	5		
Fracture	1	15	1		2	2	4	13	13		2		10	1	8	11	7	15	8	11
Concussion		1	1			1	1	3	1		1	1	1	1	4	5	1	5	3	
2+ Injuries		3	1					3	3		1	2	1	3	4	2	2	5	7	

Table 14
Activity x Probable Direct Cause
for Grades 7-9

Probable Direct Cause	Activity																					
	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
Blow by Object		39	2	6	7		8	4		6	3	9	7	10	14	23		35	8	1
Fall or Trip	1	18	2	2	1		6	4	14	1	8		8	2	10	8	1	24	12	7
Fall on Apparatus	1							44	6		1		1	2	26	1	2	3	4	2
Osbtruction		1				1		2	1	1			3		3	3	1	5	2	1
Accidental Collision	1	20	4	2	1		7	1	2	1	4		22		2	11	2	17	9	1
Normal Body Contact		5				5	3	3	2				5	1	2		25	6	7	1
Over-Exertion		4					1	7	17						5	3	3	4	1	1
Carelessness		2					3	7	7	1				1	14	2	1	40	6	

Table 15
Program Phase x Type of Injury
for Grades 7-9

Program Phase	Type of Injury										
	Teeth-Loose/Broken	Nosebleed	Abrasion	Laceration	Contusion	Strain	Sprain	Dislocation	Fracture	Concussion	2+ Injuries
Physical Education	20	6	14	54	105	77	119	24	94	22	24
Intramurals	4		2	6	14	5	9		11		4
Interscholastics	1		1	4	9	5	13	2	12	1	5
Recess	2				3	2	2		3	1	
Before/After School	19		6	38	29	7	14	4	18	4	10
Classroom	6	3	36	129	28	4	7	1	9	7	8

Appendix D

Tables for Grades 10-12

Table 16
Program Phase x Activity
for Grades 10-12

Program Phase	Activity	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing	Total
	Physical Education	11	24	1	1	8		20	31	22	21	13	8	6	5	5	15	8	24	22	3	348
	Intramurals		4								3		3	1			2		2	2		17
	Inter-Scholastics	4	9				25	1	2	3			1	4		2	8	2	1	3		65
	Recess								1		1								4	3		9
	Before/ After School		4				1	2		1	1		1					1	3	6		20
	Classroom									1		1		1					22	5	1	31

Table 17
Activity x Body Region
for Grades 10-12

Body Region	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
Head	3	3			2		6	1		4	3	3			1	1		6	8	
Face	4	4					2			3	1	5					1	5	4	1
Nose		1	1		2			1		2		1								1
Teeth		2				3	1	2	1	3			1			1		1	5	
Neck		1				1		5	5		1						1	1		
Shoulder						3	2		3		1			1			1	1		
Upper Arm										1										
Elbow/Forearm		1				1	1	3		1	2					1	2	4	2	
Wrist					1			1	4			1			1			6	3	
Hand		2			1	1		3		1	1		2	1		1	1	4	2	
Finger	2	6				2	5	1			1					5	1	14	5	1

Table 17 (continued)

Body Region	Activity																					
	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
Chest/ Abdomen						1		1						1		1	1	1	4	
Back					1	1		2	3		1		1		2	1	1	3	1	
Buttocks/ Groin													1							
Thigh		1			1		1	1	1	1	1				1	1				
Knee		2				6	2	5	2	5		1	3	1	1	1		3	2	
Lower Leg						1		3	1	1								1		
Ankle		15				2	3	3	3	3	1	1	2	1	1	9	1	2	4	1
Foot	3	3		1		1		2	6		1	1	2			1	1	4	1	
2+ Regions	2					3				1			1			2		3	1	

Table 18
Activity x Type of Injury
for Grades 10-12

Type of Injury	Activity																								
	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
Teeth-Loose/Broken	2					3	1			3			1			1		1	5	
Nosebleed		1	1		1															1
Abrasion	1								1									2	2	1
Laceration	7	2				2	2	3		5	3	6	1			1	1	23	5	
Contusion	2	3			1		5	6	2	7	5		1	1	1	2		1	8	
Strain	1	3			1	8	1	4	3	1	1	2				1	3	7	2	1
Sprain		16			2	1	3	8	11		2	2	4	1	2	9	2	3	2	
Dislocation		2				2		1	4				1	2	1		2	1	3	
Fracture		8			1	1	9	4	7	6	7	2		3	1		5	3	7	6	1
Concussion		2				1		4	1		1		1			2	1		4	4
2+ Injuries		1					1	1	1	2		1	2		1	4		1	1	

Table 19
Activity x Probable Direct Cause
for Grades 10-12

Probable Direct Cause	Activity																						
	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
Blow by Object	1	10			4	2	4	1	1	9	1	6	1	3	2	8		11	7	
Fall or Trip	1	11			2	1	2	3	5	8	9	4	3		2	11		4	5	4
Fall on Apparatus								24	5	1					1			1		
Obstruction		1								1									1	
Accidental Collision	4	10			1	3	11		1	4	1	1	5	2		2	1	6	4	
Normal Body Contact	1	7				17	3		2							1	7	3	11	
Over-Exertion	2	1				1		1	5	1			1		1		2	5	2	
Carelessness	1	1				1	2	2			1	1					1	18	2	

Table 20
Program Phase x Type of Injury
for Grades 10-12

Program Phase	Type of Injury										
	Teeth-Loose/Broken	Nosebleed	Abrasion	Laceration	Contusion	Strain	Sprain	Dislocation	Fracture	Concussion	2+ Injuries
Physical Education	13	4	3	29	39	24	49	11	51	9	10
Intramurals	1			2	2	2	2	2	3		1
Interscholastics	2		1	9	2	10	17	7	15	4	3
Recess			1	5	2	1	1			2	1
Before/After School	3		1	8	3	3	3		5	2	
Classroom	3		22	65	9	1	2	1	2	4	3

Table 21
Grade x Activity
for Grades 7-12

Grade	Aquatics	Basketball	Bordenball	Dance	Field Hockey	Tackle Football	Touch Football	Gym. Apparatus	Gym. Tumbling	Hockey	Ice Sports	Racquets	Soccer	Softball	Track and Field	Volleyball	Wrestling	Misc. Indoor	Misc. Outdoor	Skiing
Seven	3	23	4	1		1	7	19	20	3	5	1	20	3	29	16	14	68	28	4
Eight	1	30	2	2	4	1	8	32	16	3	7	6	14	8	23	18	13	35	21	10
Nine	1	43	3	2	6	4	16	34	21	4	4	3	16	6	32	28	12	62	28	11
Ten	9	23	1	1	8	6	14	28	19	15	8	8	9	5	6	12	8	24	26	2
Eleven	2	10			1	10	8	5	9	9	6	3	2		1	7	3	22	9	1
Twelve	4	8				10	1	1	1	3		2	2			6		14	8	1